

RA90 Disk Drive User Guide

Prepared by Educational Services
of
Digital Equipment Corporation

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About This Manual

This manual contains a product description and operating information for the end user of the RA90 disk drive. Drive specifications and environmental considerations are included in the introductory chapter of this manual.

The operating instructions in this manual include start-up procedures for the RA90 disk drive as well as normal on-line drive operations. A section for user troubleshooting provides some simple checks to perform before calling field service.

Installation instructions in this manual are intended for use by DIGITAL field service engineers performing original installation of the RA90 disk drive. Qualified field service engineers must have training in the following:

- RA90 disk drive
- DSA concepts
- ESD procedures

1.1 GENERAL INFORMATION

This manual contains the RA90 disk drive specifications. It describes how to install and operate the RA90 disk drive and how to perform reliability tests.

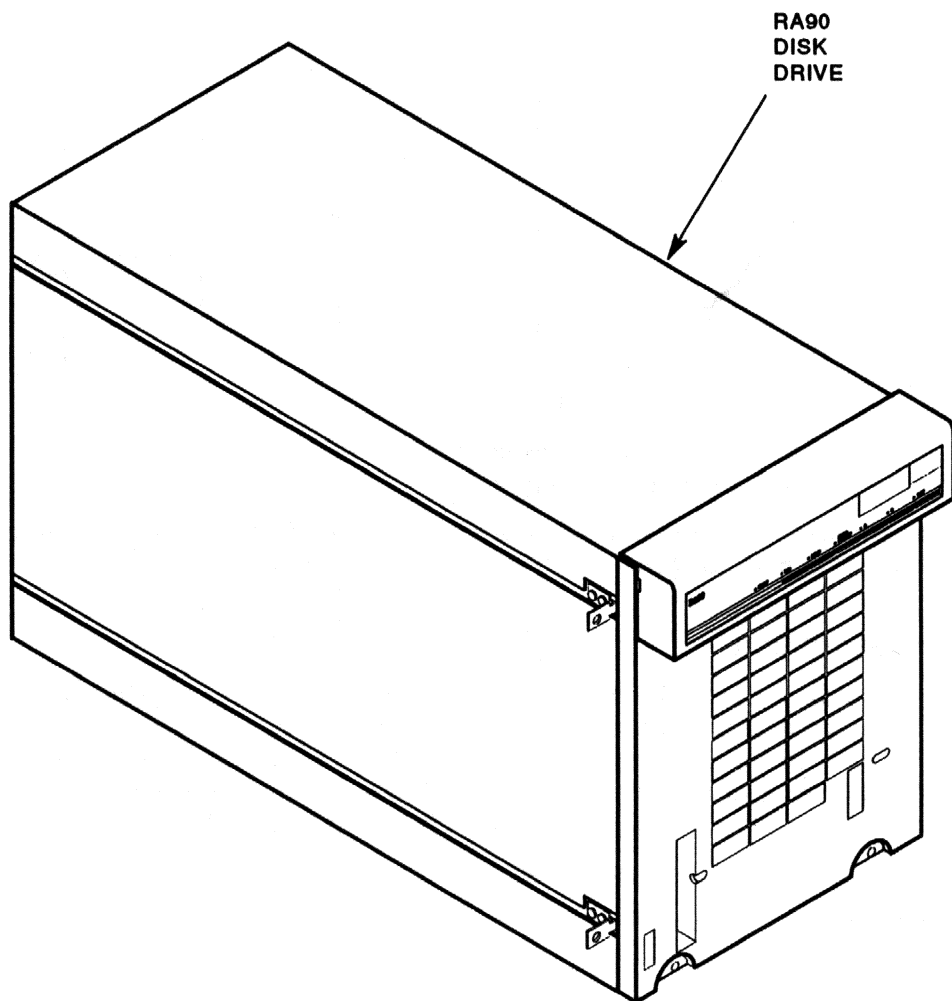
The RA90 is a member of the Digital Standard Architecture/Standard Device Interconnect (DSA/SDI) family and, therefore, is plug compatible with all DSA/SDI controllers.

1.1.1 Drive Description

The RA90 is a standalone disk drive that uses nonremovable, thin film media and thin film heads encased in a unit called the head disk assembly (HDA). The RA90 is a moving head, random access disk drive with a formatted data storage capacity of 1.216 gigabytes and an unformatted data storage capacity of 1.616 gigabytes in a 16-bit word format. The RA90 is a self-contained, independently powered and cooled disk drive. Figure 1-1 shows an RA90 standalone disk drive.

In addition, the RA90 has the following characteristics:

- 22 MHz peak data transfer rate
- Thin film heads and media
- Dedicated and embedded servo for coarse and fine track positioning
- Three internal microprocessors
- Reduced drive electronic module set
- Internal error log capabilities
- No scheduled preventive maintenance
- Extensive resident microcode diagnostics
- Multifunction operator control panel (OCP)



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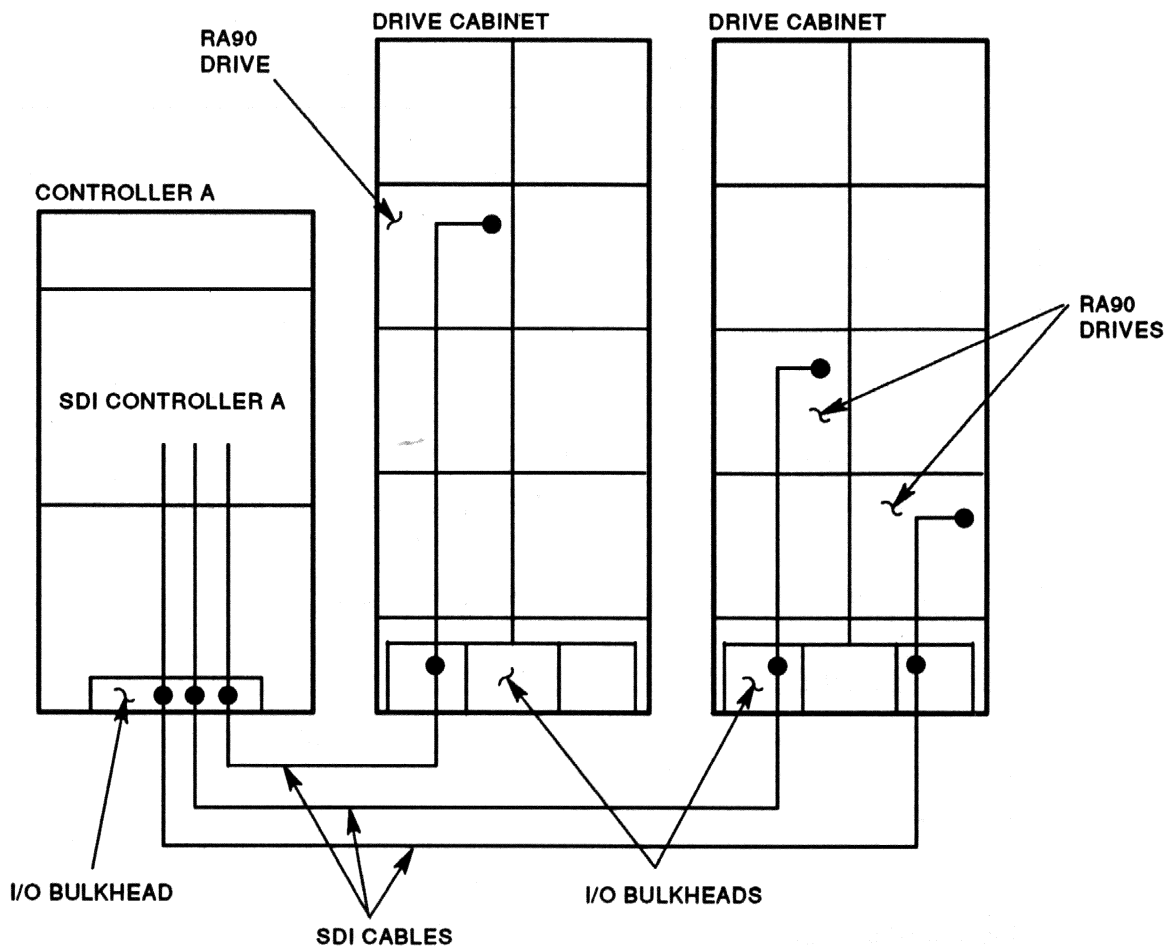
Figure 1-1 RA90 Disk Drive

Figure 1-2 is a representation of a typical RA90 subsystem configuration including an SDI controller.

1.1.2 Hardware Maintainability

The RA90 disk drive uses modular field replaceable units (FRUs) for easy access and servicing. Preventive maintenance is limited to periodic cleaning of the air filter.

Additionally, an extensive set of drive-resident microcode diagnostics and a drive-resident error log contribute to the ease of problem isolation.



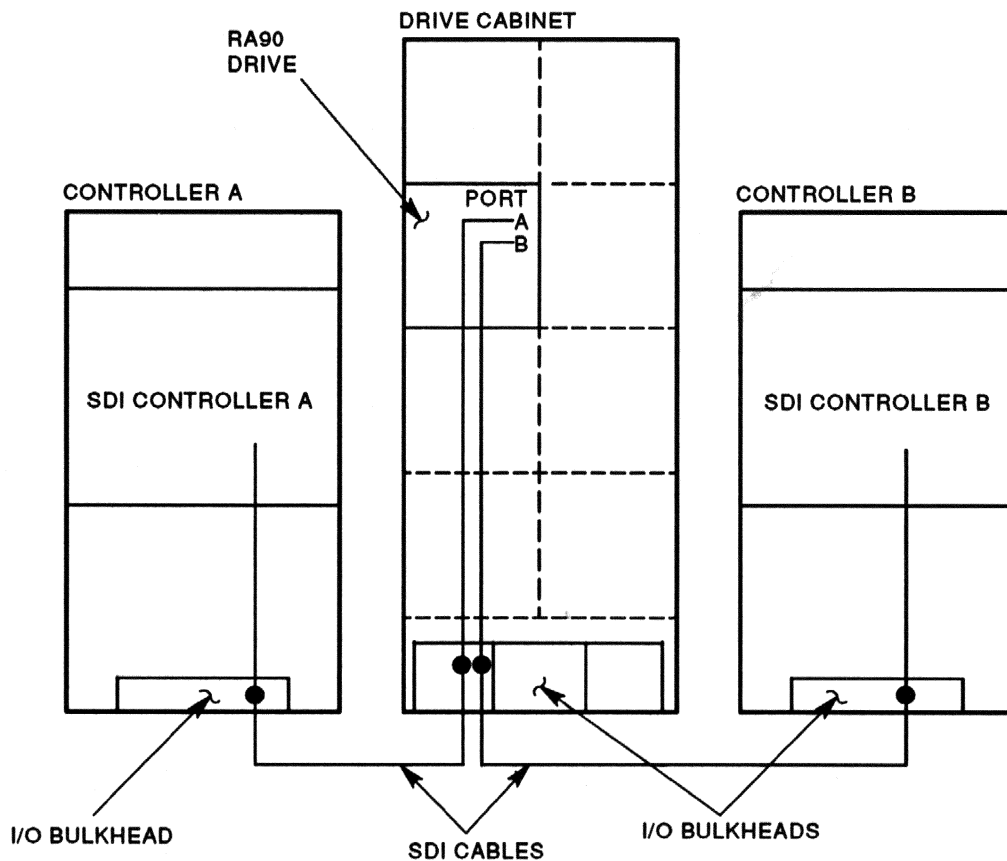
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Figure 1-2 Typical RA90 Subsystem Configuration

1.1.3 Dual-Port Capability

With both port switches selected, the RA90 disk drive operates in a static dual-port mode. Static dual porting means the RA90 can be shared between two controllers; however, the drive is on line to only one controller at a time for data transfers. The second controller must wait until the drive is available before placing the drive on line to itself.

Ports are selected by the port select switches (A or B) on the front of the operator control panel (OCP). An additional SDI cable is required for dual porting. Figure 1-3 shows an RA90 dual-port configuration.



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Figure 1-3 RA90 Dual-Port Configuration

1.1.4 Drive-Resident Diagnostics

Drive-resident diagnostics run during power-up and spin-up cycles and test basic drive functions. Additionally, resident diagnostics are invoked by the drive any time the drive enters an idle-loop state and neither port is selected.

Resident diagnostics can also be run from the OCP while the drive is off line. See Chapter 4 for a listing of these diagnostics.

1.2 RA90 USER PRECAUTIONS/RECOMMENDATIONS

Data is not recoverable on an inoperable HDA. It is, therefore, up to the user to protect data by using proper backup procedures. The following methods of backup are recommended for the RA90:

- **File duplication** - This normally involves copying the data on removable media such as magnetic tape.
- **Journaling** - This method is recommended for files in a transaction processing application. It allows reconstruction of files up to the last checkpoint or backup.

CAUTION

Data is not recoverable on an inoperable HDA. Data must be backed up.

1.2.1 Recommended Operating Temperature

The RA90 can be operated within a temperature range of 10°C to 40°C (50°F to 104°F).

It is, however, highly recommended the RA90 be operated in a temperature range below 25°C (77°F) to realize increased reliability and life of product.

1.2.2 Electrostatic Discharge

Electrostatic discharge (ESD) is caused by the buildup and release of static electricity. An electrical charge from a person or object can damage hardware components and result in premature device or option failure.

1.2.3 Electrostatic Protection

The basic concept of complete static protection for electronic components is the prevention of static buildup, where possible, and the quick reliable discharge of static buildup.

If the charged object is a conductor, complete discharge can be achieved by grounding.

CAUTION

To avoid product damage, always use grounding straps when handling static-sensitive modules and components.

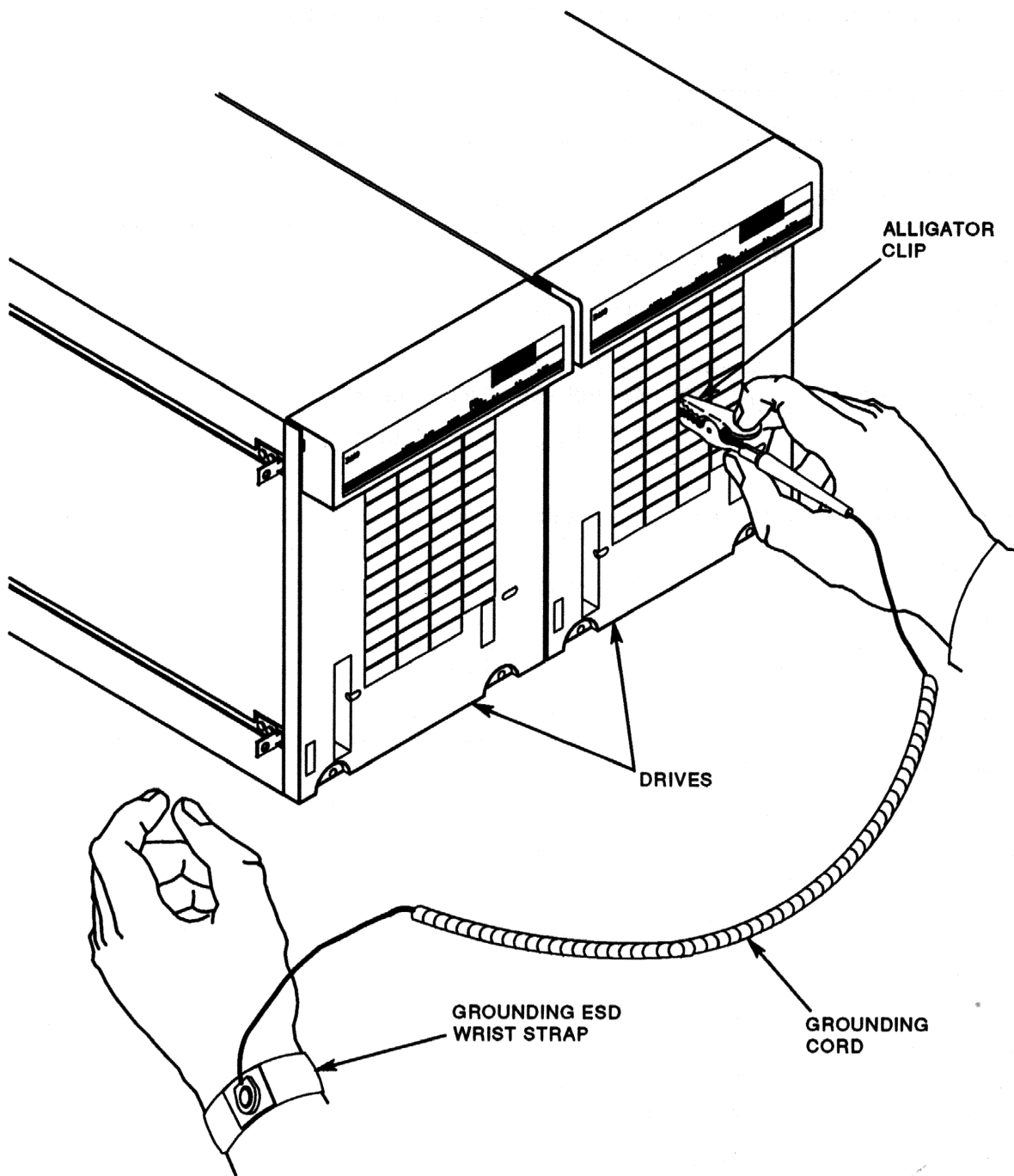
Use the following guidelines when handling static-sensitive components and modules:

1. Be properly grounded when handling modules, components, or static-sensitive devices.
2. Use static-protective containers to transfer modules and components (including bags and tote boxes).

Figure 1-4 shows the electrostatic wrist strap in use. Note that the grounding cord connects the wrist strap and the conductive work surface to ground.

When using an ESD wrist strap:

1. Ensure the wrist strap fits snugly for proper conductivity.
2. Do not overextend the grounding cord.
3. Attach the alligator clip securely to a clean, unpainted, grounded, metal surface such as the drive or cabinet chassis.



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Figure 1-4 ESD Wrist Strap

1.3 DESCRIPTION OF MAINTENANCE STRATEGY

The repair strategy for the RA90 is replacement of the failing field replaceable unit (FRU). Internal error logs and resident/host-level diagnostics are used to isolate the failing FRU.

It is recommended that only trained field engineers attempt to service the RA90 disk drive.

1.4 RA90 DISK DRIVE SPECIFICATIONS

Table 1-1 lists important operating and nonoperating RA90 disk drive specifications.

Table 1-1 RA90 Specification Table

Characteristic	Specification
Head Disk Assembly (HDA)	
Storage capacity	1.216 gigabytes (formatted)
Storage capacity	1.616 gigabytes (unformatted)
HDA word format	16-bit only
Bits/square inch	40 megabits
Tracks/inch	1750
Disk recording method	Rate 2/3 modulation code
Number of disks	7
Disk surfaces	14 (13 data and 1 servo)
Number of heads	14
Heads per surface	1
Number of tracks	37,254
Logical cylinders	2656
User logical cylinders	2649
Number of sectors	69 + 1 spare
Number of logical blocks	2,376,153

Maximum Seek Times

Full cylinder seek	30.5 milliseconds
One cylinder	4.0 milliseconds
Average seek	17.5 milliseconds (19.0 milliseconds with subsystem overhead)

Table 1-1 (Cont.) RA90 Specification Table

Characteristic	Specification
Latency	
Speed	3600 r/min
Maximum latency	16.67 milliseconds
Average latency	8.33 milliseconds
Single Start/Stop Time	
Start (maximum)	40 seconds
Inhibit between stop and restart	40 seconds
Data Rates	
Bit rate	22.1 megabits
Byte rate (8-bit)	2.1 megabytes
Environmental Limits (Maximum)	
Temperature (Required)	
Operating	10 to 40°C (50 to 104°F) with a temperature gradient of 20°C/hour (36°F/hour)
Nonoperating	-40 to +60°C (-40 to +140°F)
Relative humidity	
Operating	10% to 90% (noncondensing) with a minimum wet bulb temperature of 28°C (82°F) and a minimum dew point of 2°C (36° F)
Nonoperating	10% to 90% with no condensation
The following are recommended environmental ranges to optimize equipment performance and reliability:	

Table 1-1 (Cont.) RA90 Specification Table

Characteristic	Specification
Environmental Limits Recommended Range	
Temperature	18 to 24°C (64.4 to 75.2°F) with an average rate of change of 3°C/hour maximum and a step change of 3°C or less
Relative humidity	40% to 60% (noncondensing) with a step change of 10% or less (noncondensing)
Air quality (maximum particle count)	Not to exceed 500,000 particles per cubic foot of air at a size of 0.5 micron or larger
Air volume (at inlet)	50 cubic feet per minute (.026 cubic meters per second)
Altitude	
Operating	Sea level to 2400 meters (8000 feet). Maximum allowable operating temperatures are reduced by a factor of 1.8°C/1000 meters (1°F/1000 feet) for operation above sea level.
Nonoperating	300 meters (1000 feet) below sea level to 7500 meters (16,000 feet) above sea level (actual or effective by means of cabin pressurization)
Physical Characteristics	
Height	26.56 cm (10.42 inches)
Width	22.19 cm (8.74 inches)
Depth	68.47 cm (26.96 inches)
Weight	31.8 kg (70 pounds)
Inrush Current	
120 Vac, 60 Hz	60 amperes peak @ 132 Vac
220-240 Vac, 50 Hz	70 amperes peak @ 264 Vac
Running current for:	
120 Vac, 60 Hz	4.6 amps
220-240 Vac, 50 Hz	2.4 amps
Power factor:	
120 Vac, 60 Hz	0.7
220-240 Vac, 50 Hz	0.58

Table 1-1 (Cont.) RA90 Specification Table

Characteristic		Specification	
Line cord length (from the cabinet)		2.74 meters (9 feet)	
Nominal Voltage	Input Current	Power Dissipation	BTUs/Hr
101	3.5 amps RMS	217 watts	925
120	3.1 amps RMS	282 watts	962
220	2.0 amps RMS	280 watts	956
240	1.9 amps RMS	283 watts	966

2

INSTALLATION

2.1 INTRODUCTION

This chapter describes the installation procedures for the RA90 disk drive. Safety precautions, site preparation, planning, cabling, and acceptance testing are also covered.

2.2 SITE PREPARATION AND PLANNING

Site preparation and planning are necessary before installing an RA90 disk subsystem. Consider the following items before installation.

2.2.1 Power Requirements

The RA90 disk drive uses a single-phase power supply; however, operating voltages are supplied to the drive through an 881 power controller. The 881 power controller is a three-phase controller requiring the presence of three-phase power.

2.2.2 Thermal Stabilization

Equipment must be placed in its operating environment at least 24 hours prior to operation. Thermally stabilizing the equipment prevents temperature differences from causing problems to drive components.

CAUTION

This equipment must be thermally stabilized in its site environment before being operated. Twenty-four hours is the required stabilization time period. Failure to stabilize may cause premature equipment failure.

2.2.3 Environment

The RA90 disk drive must be operated in an environment where the ambient air particle count does not exceed 500,000 particles (larger than 0.5 micron) per cubic foot of air.

2.2.4 Floor Loading

Consider the placement of this equipment. A fully loaded 60-inch cabinet weighs 402 kilograms (885 pounds). Each RA90 disk drive weighs approximately 31.8 kilograms (70 pounds).

2.2.5 Operating Temperature and Humidity

The required relative humidity range is between 10% and 90% with a minimum wet bulb temperature of 28°C (82°F) and a minimum dew point of 2°C (36°F) (noncondensing) with a step change of 10% or less.

The RA90 can be operated in temperatures ranging from 10°C to 40°C (50°F to 104°F).

It is, however, highly recommended that the RA90 be operated in a temperature below 25°C (77°F) to increase reliability and extend the life of the RA90.

2.3 INSTALLING RA90 ADD-ON DRIVES IN 60-INCH CABINETS

This section describes RA90 disk drive installation in 60-inch cabinets. Under most conditions, drive hardware has been installed in the original SA configuration. However, details of drive installation are provided as a reference.

Cabinet stability and drive accessibility are prime considerations when adding a disk drive to an existing cabinet configuration. Section 2.3.4 offers the recommended order for add-on RA90 disk drives.

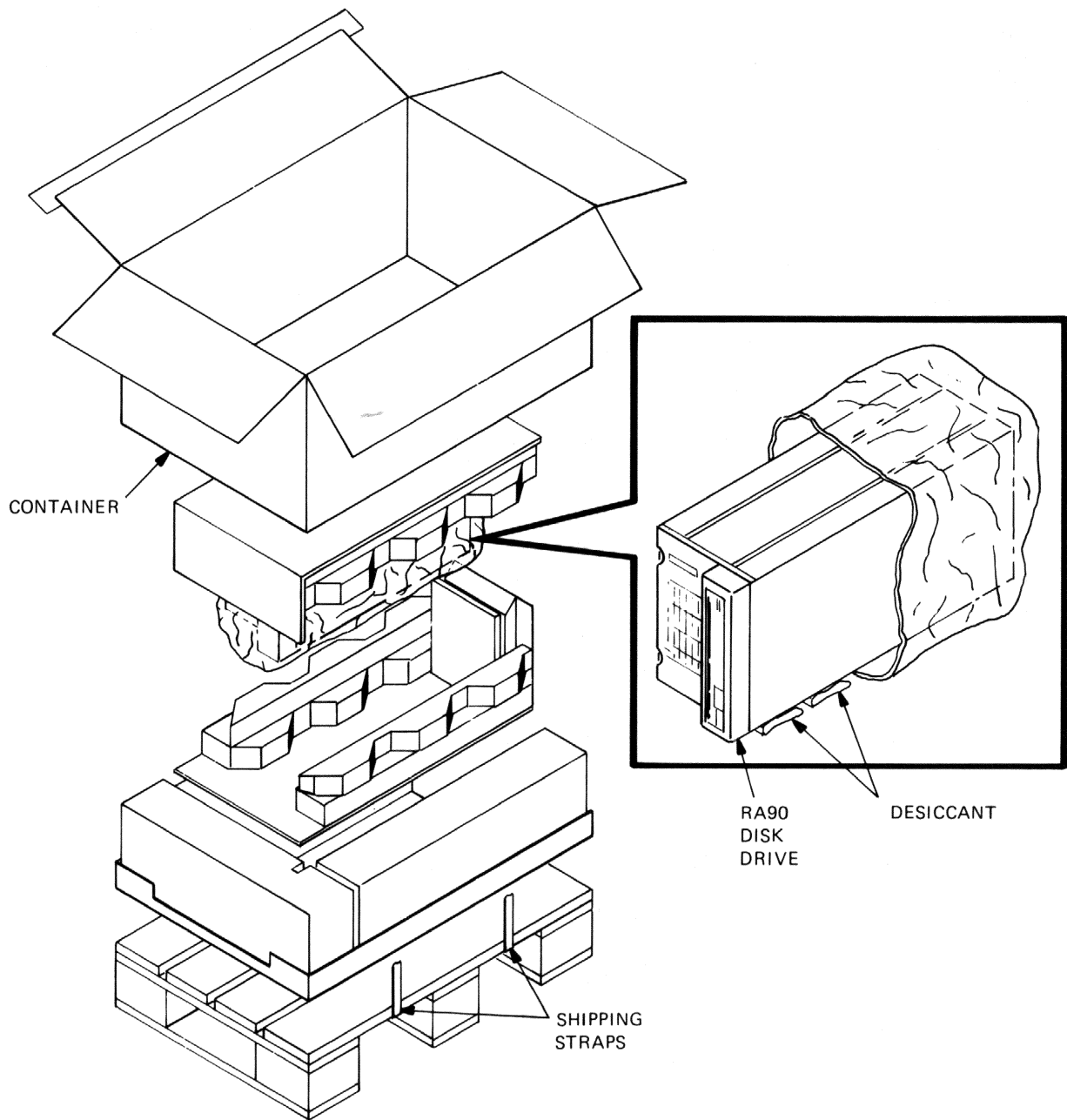
2.3.1 Unpacking the RA90 Disk Drive

Check packaging for external damage. Read and save any packing information. Keep all packing material and receipts in case of damage or problems with the equipment. Refer to Figure 2-1.

1. Remove the shipping straps.
2. Open the container.
3. Remove the packing material from around the drive.
4. Remove the drive.

WARNING

Drives weigh 31.8 kilograms (70 pounds) and must be handled with care.



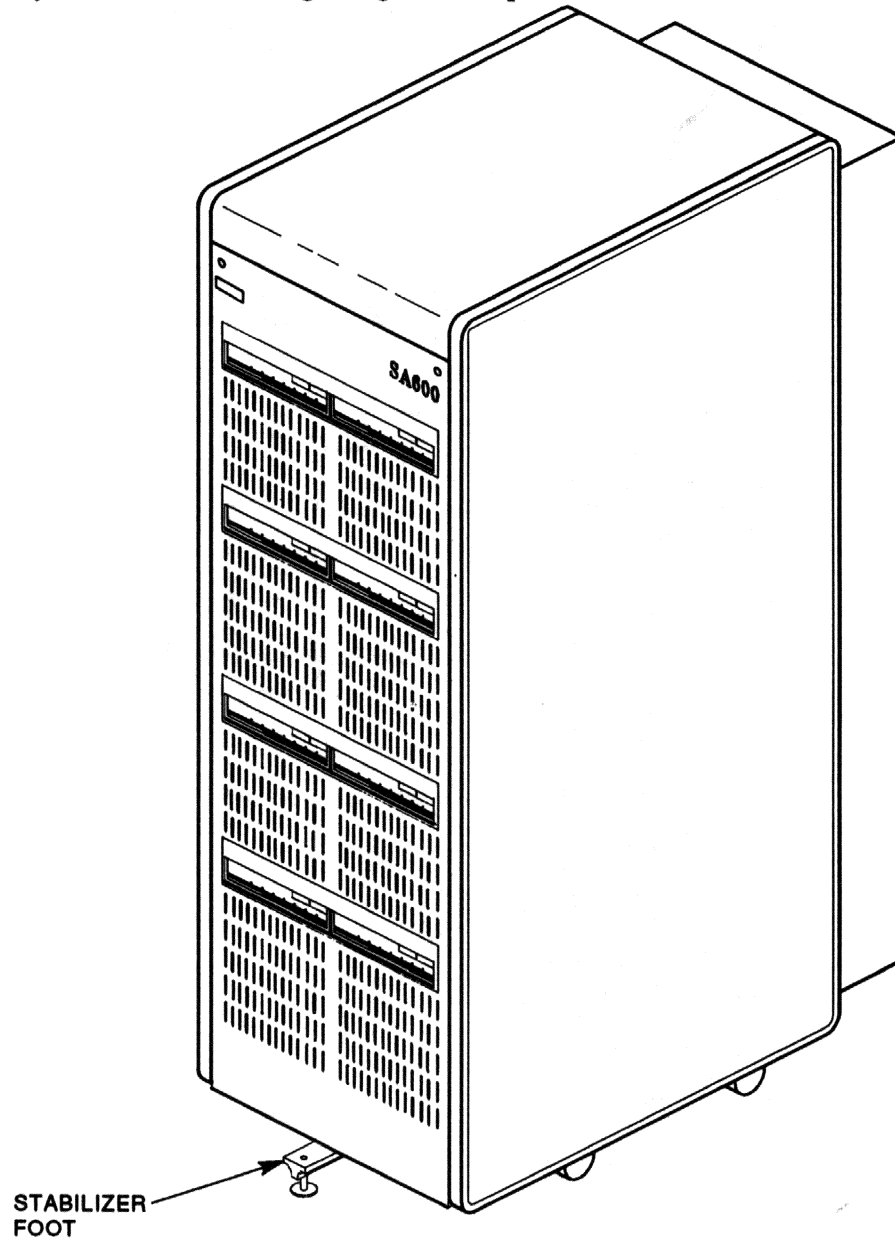
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Figure 2-1 RA90 Disk Drive Packaging

2.3.2 Preparing the Cabinet

Refer to Figure 2-2 for this procedure.

1. Pull stabilizer foot (located at center bottom of cabinet) forward.
2. Lower stabilizer foot until it makes firm contact with the floor.
3. Ensure stability of cabinet before beginning the next procedure.



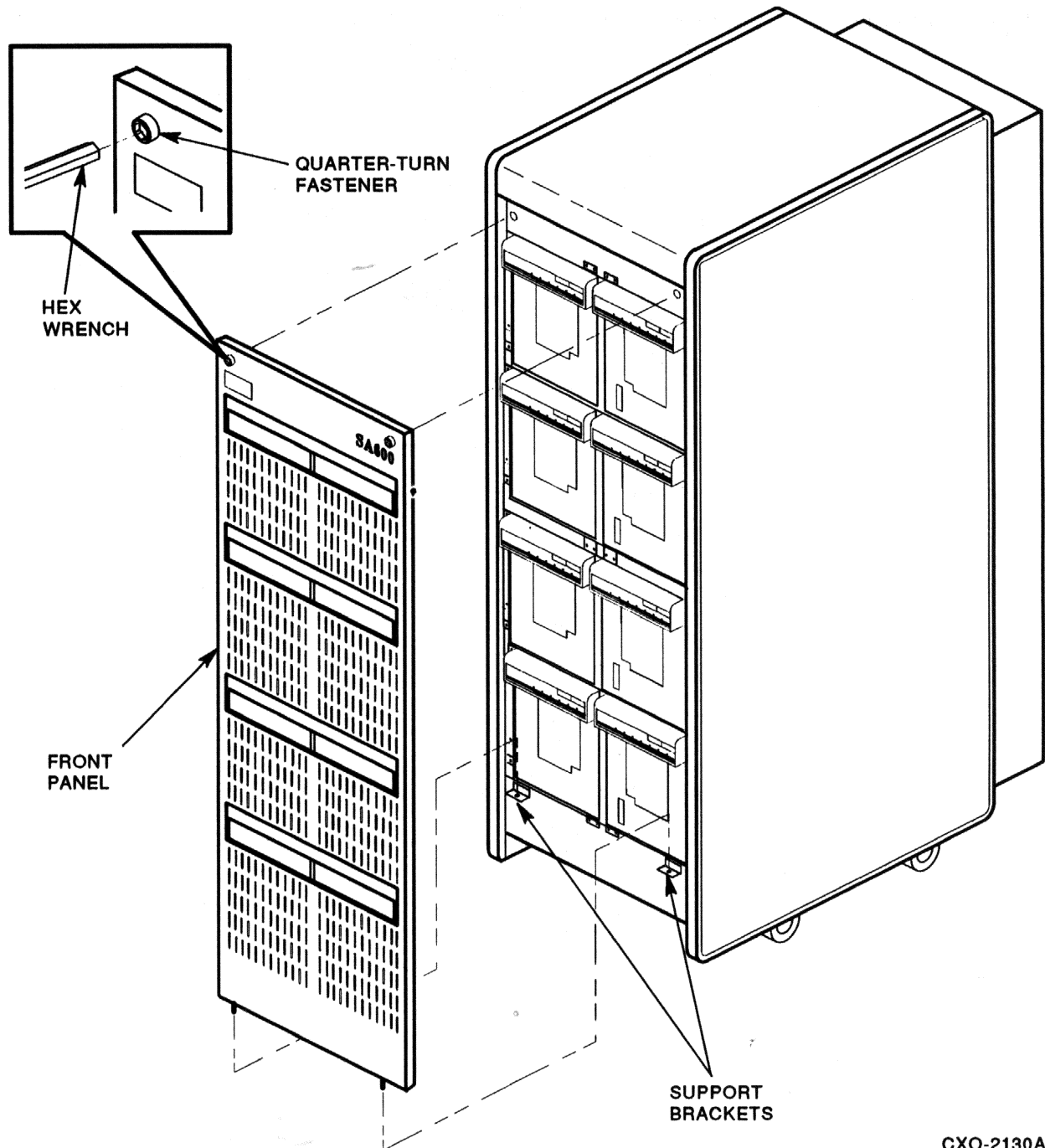
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Figure 2-2 Stabilizer Foot

2.3.3 Removing the Front and Rear Access Panels

Use the following procedure to remove front and rear cabinet access panels. Refer to Figure 2-3 and Figure 2-4 while performing this operation.

Refer to Figure 2-3 and remove the front access panel as follows:



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Figure 2-3 Front Panel Removal

1. Unlock the two quarter-turn fasteners at the top of the panel. Use a hex wrench to turn the fasteners counterclockwise.

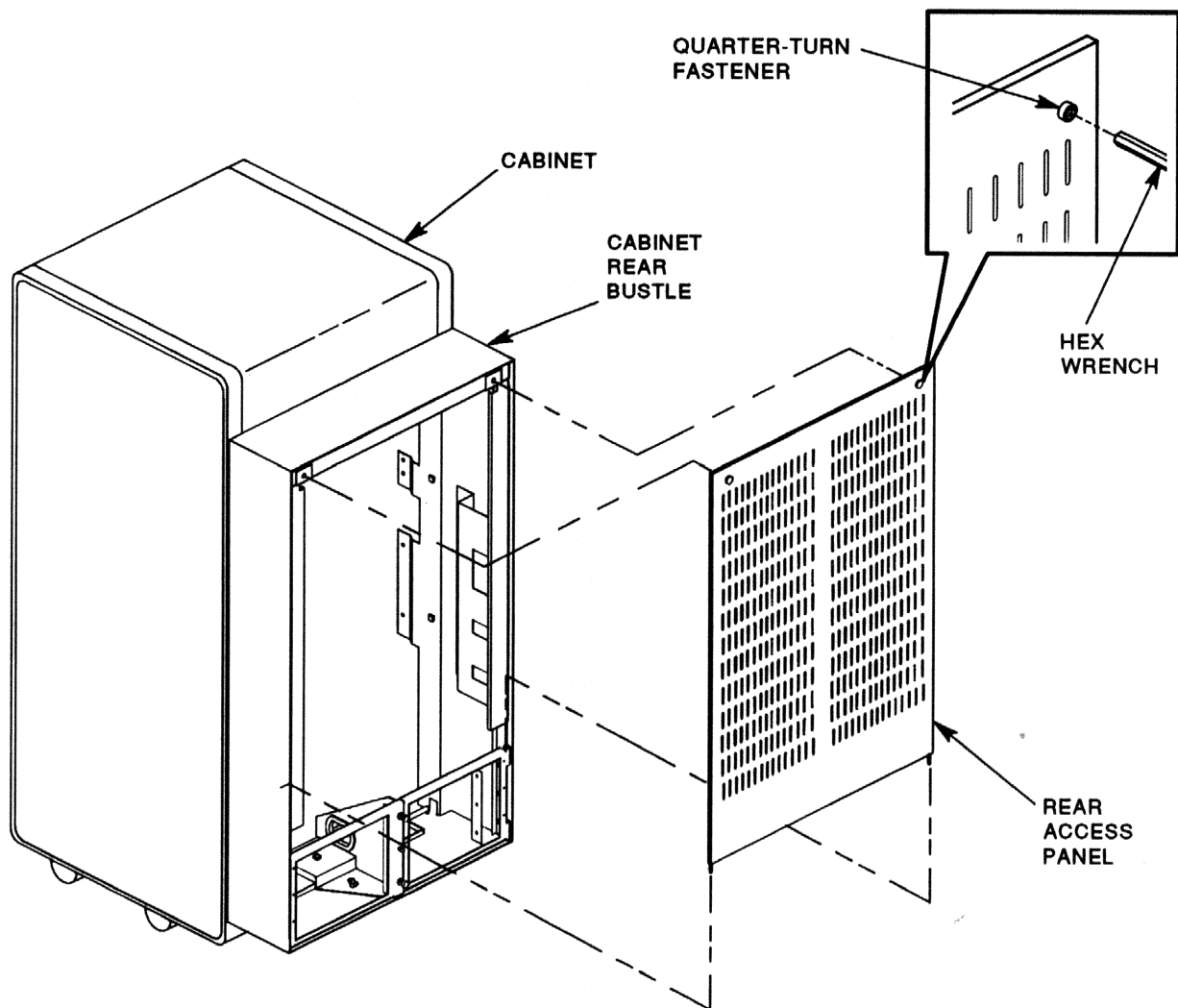
2. Grasp the panel by its edges, tilt it toward you, and lift it up about 2 inches. Remove and store the panel in a safe place.

To reinstall the front panel, lift it into place and lower it straight down until the pins on the lower edge of the panel engage the holes in the cabinet. Hold the panel flush with the cabinet and lock the fasteners.

Refer to Figure 2-4 and remove the rear access panel as follows:

1. Turn the two quarter-turn fasteners located at the top of the panel counterclockwise.
2. Tilt the panel toward you and lift it up to disengage the pins at the bottom.
3. Lift the panel clear of the enclosure.

When replacing the rear panel, lift it into place and fit the pins into the holes at the top of the I/O bulkhead. Push the top of the panel into place and turn the quarter-turn fasteners clockwise to lock.

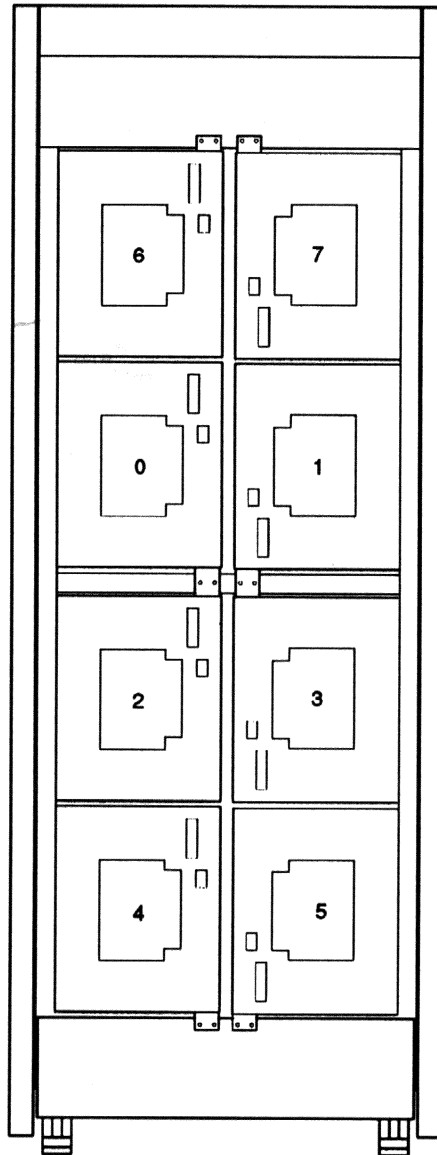


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Figure 2-4 Rear Access Panel Removal

2.3.4 Drive Add-On Order

Refer to Figure 2-5 for the suggested order of add-on drives. Each cabinet location has a number associated with it. These numbers represent the recommended add-on sequence for the RA90 disk drive.



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Figure 2-5 Drive Add-On Order

2.3.5 Installing the Chassis

Refer to Figure 2-6 while performing installation of the drive chassis.

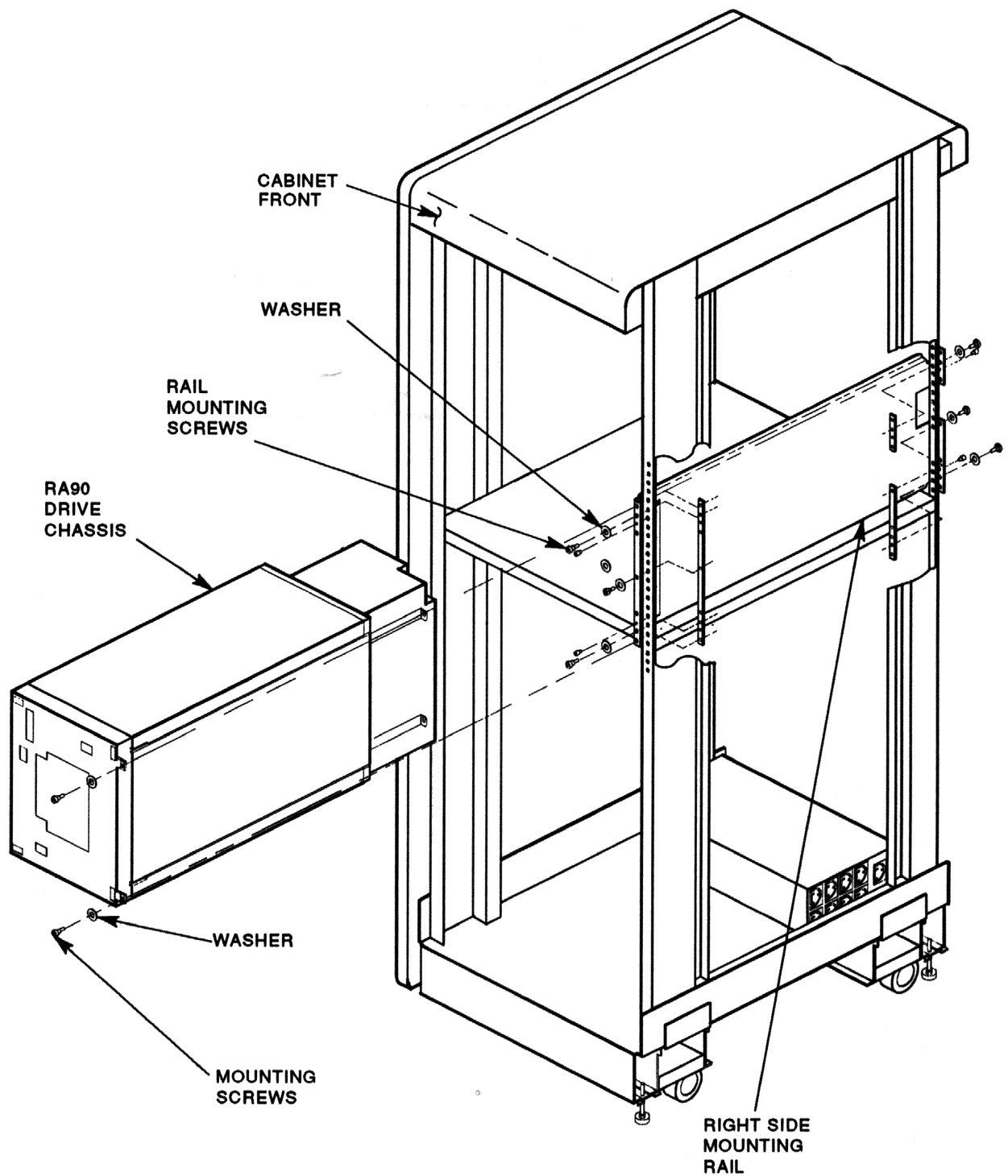
1. Select the appropriate drive position (Figure 2-5).
2. Slide the drive onto the pre-mounted hardware.
3. Bolt the chassis to the center support bracket.

2.4 SDI AND POWER CABLE INSTALLATION

This section documents external and internal SDI cable and power cord installation. A fully configured cabinet has internal SDI cables and power cords in place. This section is intended as a reference.

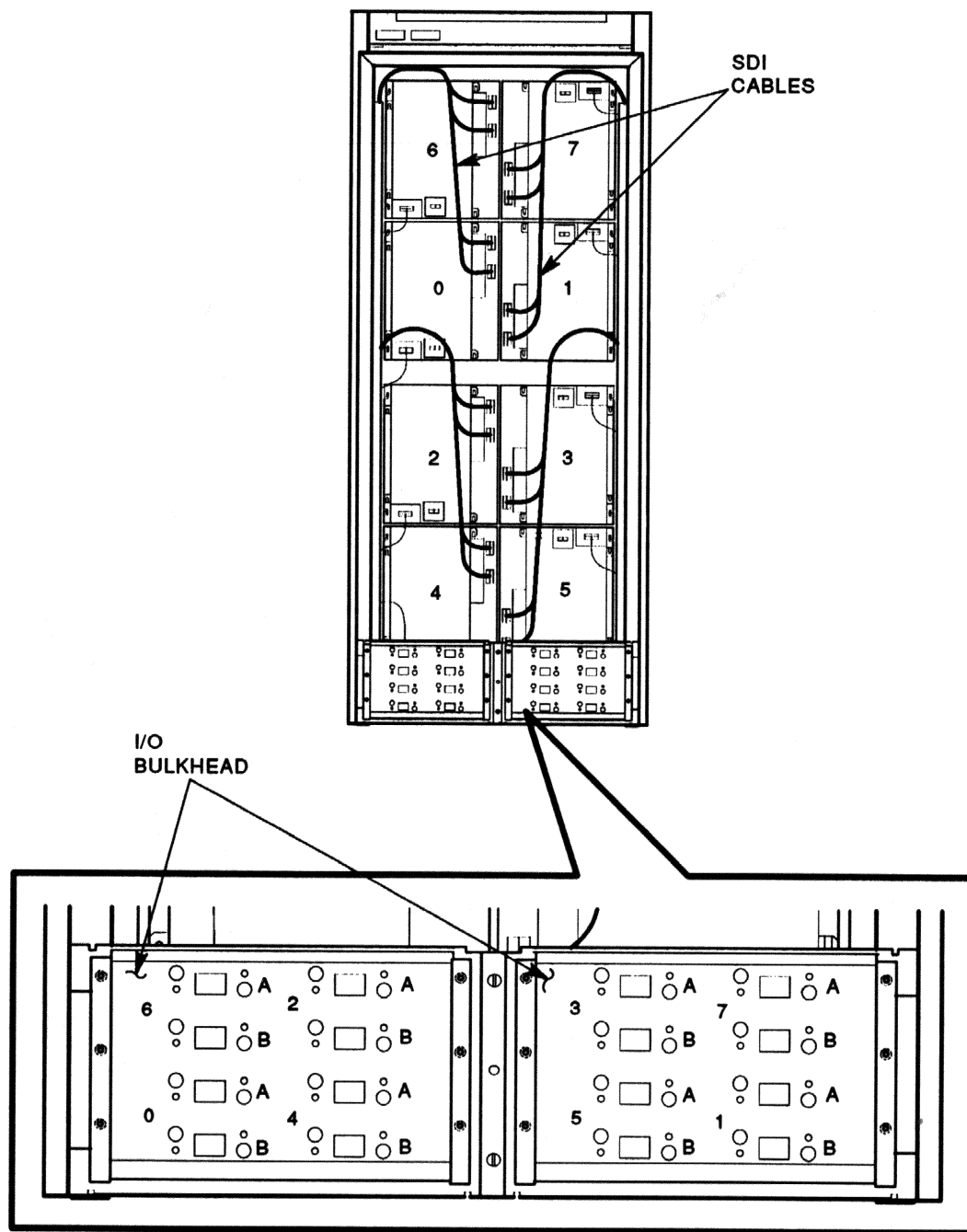
Both external and internal SDI cable connections are made to the I/O bulkhead located at the base of the drive cabinet. See Figure 2-7.

Drive power cord connections are made to the 881 power controller located behind the I/O bulkhead at the bottom of the cabinet. Refer to Figure 2-8 when connecting power cords.



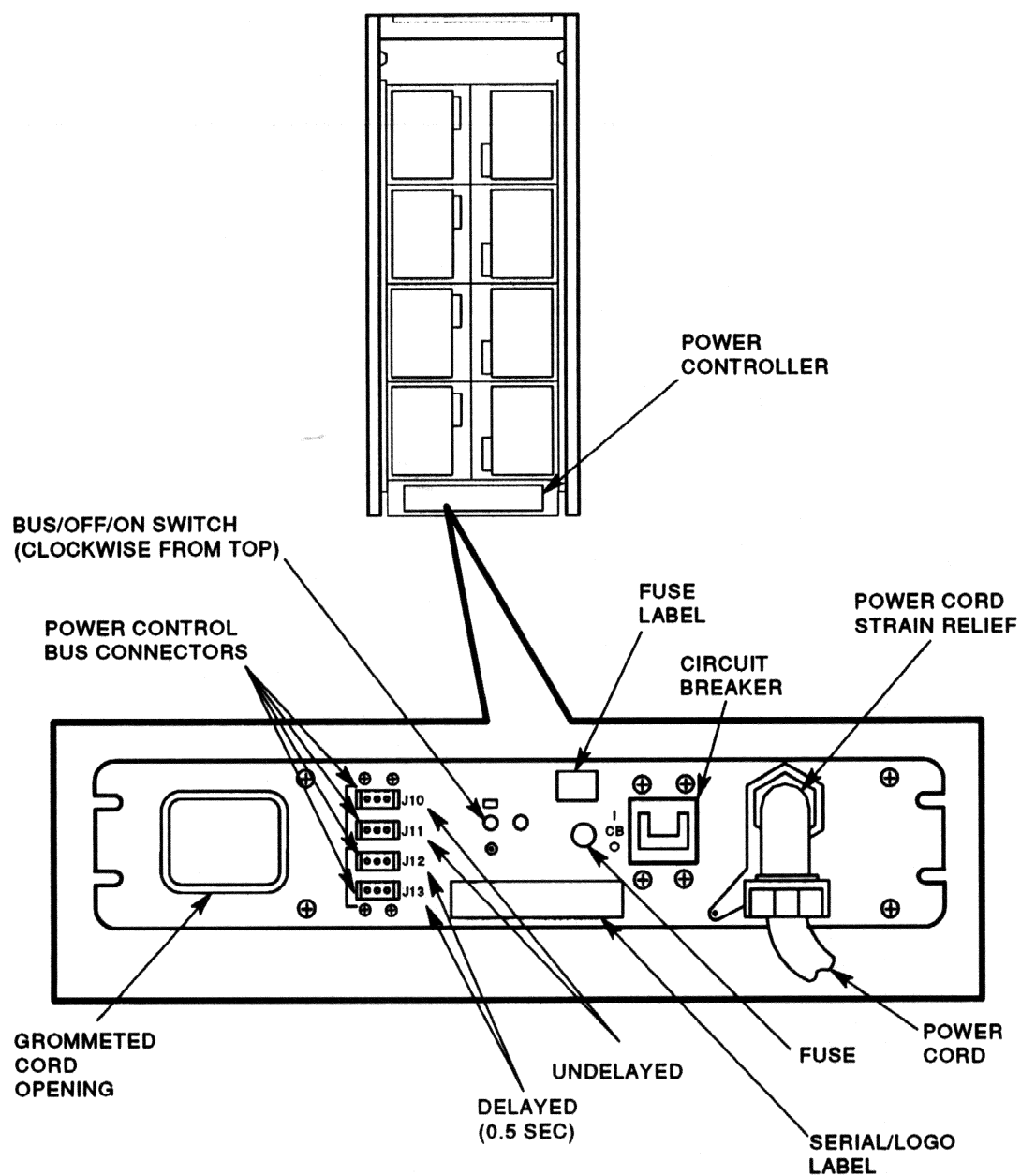
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Figure 2-6 Chassis Installation



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Figure 2-7 I/O Bulkhead

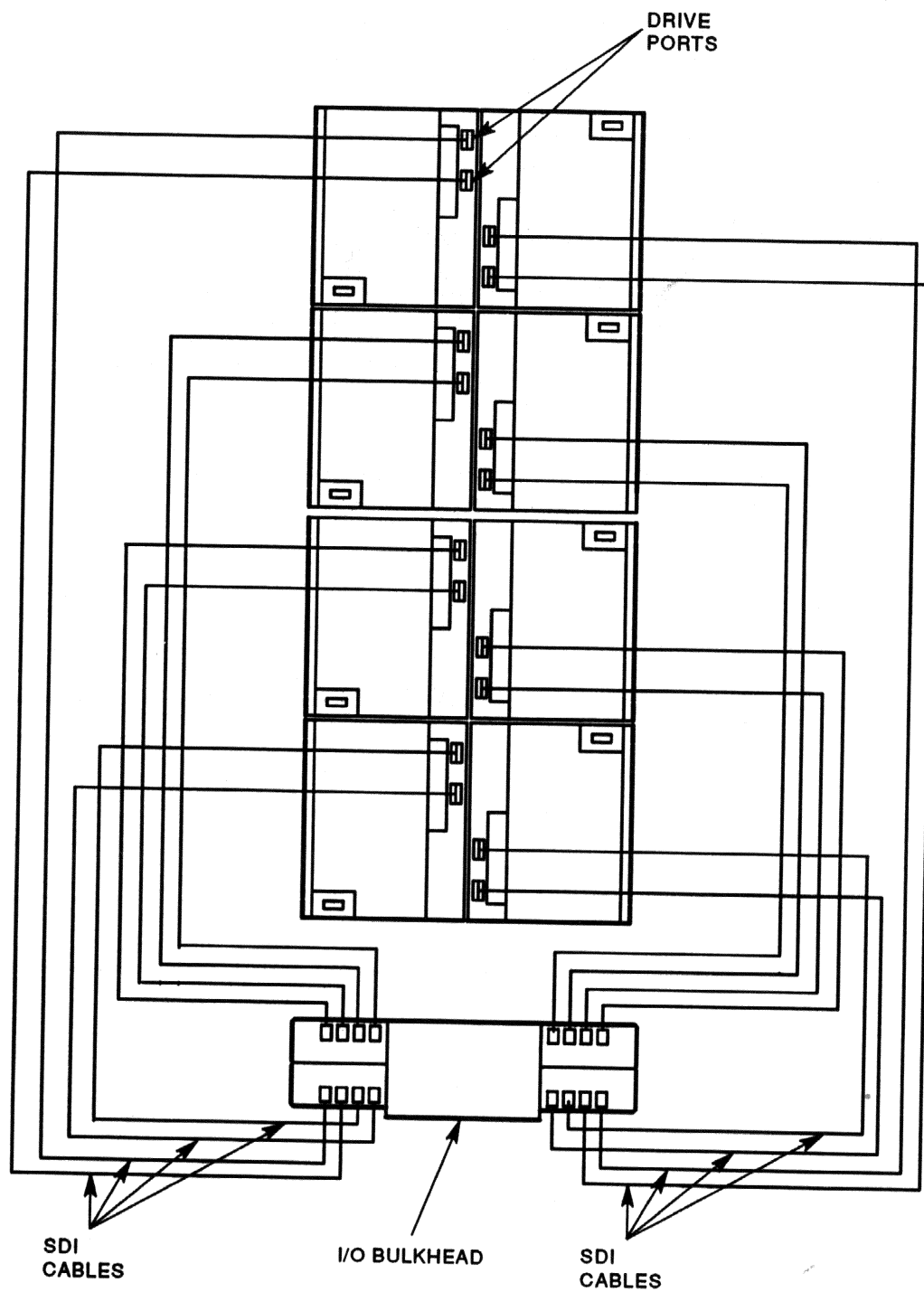


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Figure 2-8 Power Controller

2.4.1 Internal SDI Cable Installation

Figure 2-9 shows the routing of internal SDI cables in a fully configured RA90 cabinet. Use this example when installing or moving SDI cables.



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Figure 2-9 Cable Routing

2.4.2 Internal Power Cord Installation

Figure 2-10 shows the internal cabinet power cord routing in a 60-inch cabinet with eight RA90 disk drives. Use this example when installing or moving power cables.

2.4.3 Installing External SDI Cables

Refer to Figure 2-7 for cable-to-port connections when installing external SDI cables.

2.5 POWER AND SAFETY PRECAUTIONS

The RA90 does not present any unusual fire or safety hazards. It is, however, recommended you check ac power wiring for the computer system to determine adequate capacity for expansion.

To protect personnel and equipment, ensure power sources meet the specifications required for this equipment.

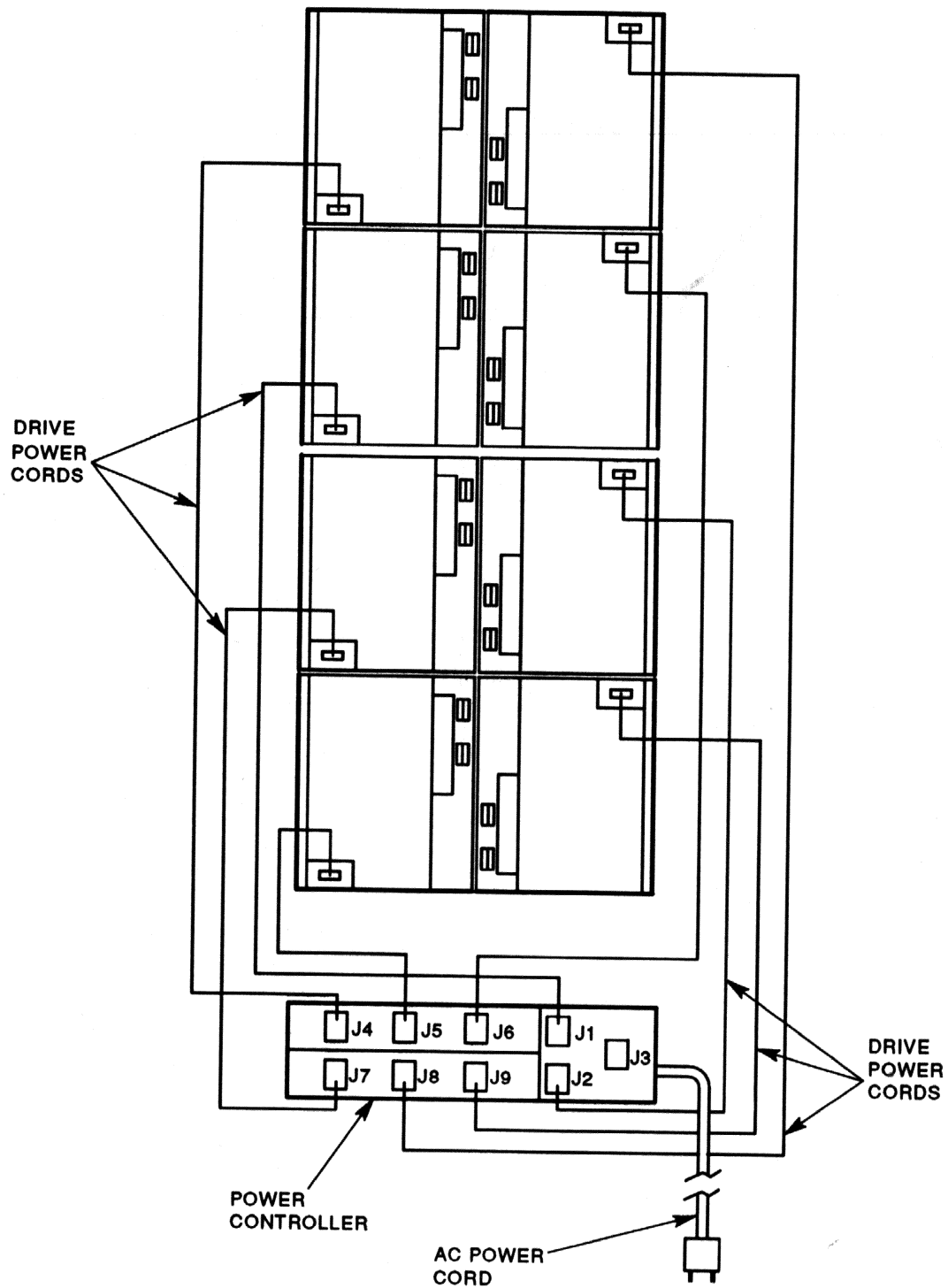
WARNING

Hazardous voltages are present in this equipment. Installation and service must be performed by trained service personnel. Bodily injury or equipment damage may result from incorrect servicing.

2.5.1 AC Power Wiring

Three-phase power must be present in order to support the installation of an 881 power controller.




The wiring used by Digital Equipment Corporation conforms to UL, CSA, and ISE standards. Figure 2-11 shows the ac plug configurations for the RA90 disk drive and the 881 power controller.







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Figure 2-10 Power Cord Routing

POWER CORDS GOING TO POWER CONTROLLER (FROM REAR OF ENCLOSURE)

120V 60HZ POWER CORD DEC NO. A-PS-1700083-23	
240V 50HZ POWER CORD DEC NO. A-PS-1700083-24	
120/240V 47-63HZ 10A/6A POWER CORD DEC NO. A-PS-1700442-18 OR A-PS-1700442-19 USED WITH 881 POWER CONTROLLER	

PLUGS GOING TO WALL OUTLET (FROM CONTROLLER)

40-INCH CABINET	120V 60HZ 30A 1-PHASE		NEMA NO. L5-30P DEC NO. 12-11193
	240V 50HZ 20A 1-PHASE USED WITH H874B POWER CONTROLLER		NEMA NO. L6-20P DEC NO. 12-11192
60-INCH CABINET	120/208V AC 60HZ 30A 3-PHASE WYE USED WITH 881-A AND 881-C POWER CONTROLLERS		5-WIRE NEMA NO. L21-30P
	220-240/380-415V AC 50HZ 20A OR 16A 3-PHASE WYE USED WITH 881-B POWER CONTROLLERS		5-WIRE, 4-POLE, IEC 309

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Figure 2-11 Electrical Plug Configurations

2.5.2 Plugging in the Power Cord

A configured cabinet already has the drive power cords plugged into the controller. Only the ac power cord from the controller needs to be plugged into an external power source.

CAUTION

Do not apply power to the power controller until you are ready to perform the drive checkout procedures.

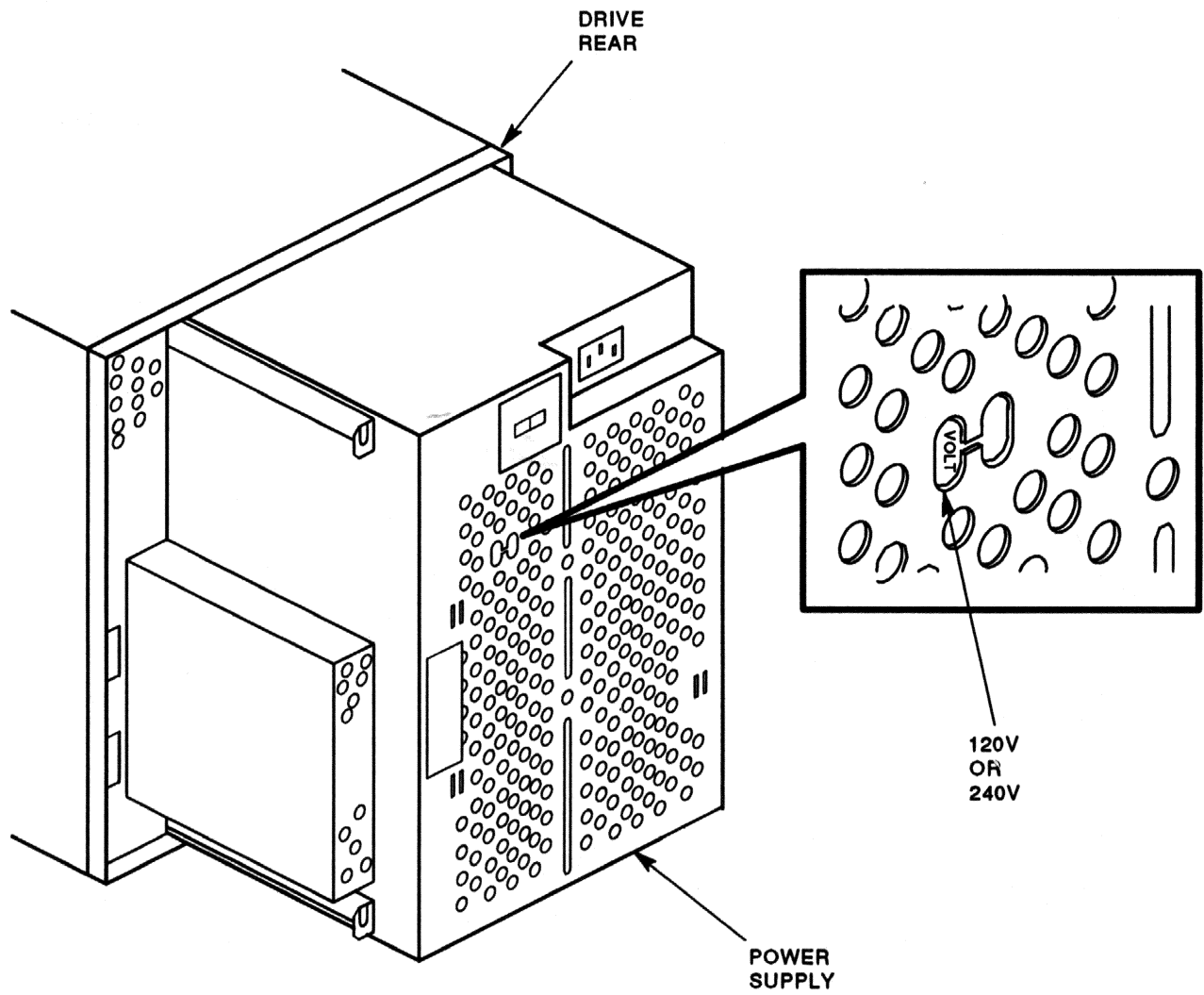
2.6 VOLTAGE SELECTION

It is important to ensure the RA90 disk drive has the proper voltage selected for your area. The voltage selector is a slide switch capable of selecting 110 V/60 Hz or 220 V/50 Hz. Perform the following steps:

WARNING

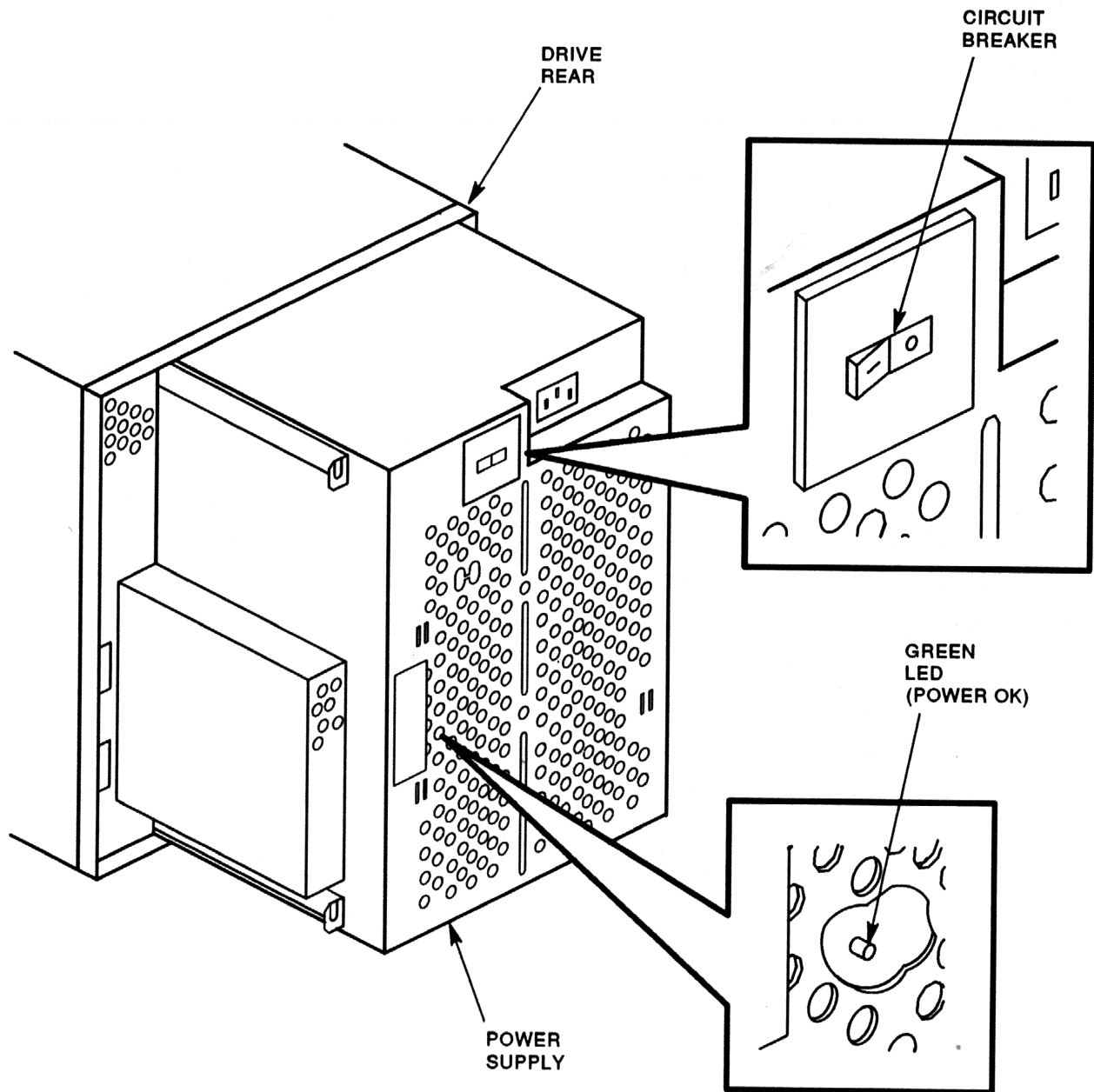
Ensure that both the controller and drive are operating at the same voltages and frequencies (120 V/60 Hz or 240 V/50 Hz). Use the following procedure to select the proper voltage.

1. Remove the cabinet rear access panel (Figure 2-4).
2. Refer to Figure 2-12 for voltage selector location.
3. Select the desired voltage by sliding the switch into the proper position using a non-conductive pointed object.
4. Verify the ac circuit breaker on the power control unit is off.
5. Verify the circuit breaker on each disk drive is off.
6. Verify the voltage selector (Figure 2-12) is in the correct position for your area.
7. Ensure the drive power cord is plugged into the power controller.
8. Plug the ac power cord from the power controller into an external receptacle.
9. Switch on the ac circuit breaker on the power controller.
10. Switch the RA90 drive circuit breaker on (I) (Figure 2-13).



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Figure 2-12 Voltage Selector



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Figure 2-13 Drive Circuit Breaker Location

CAUTION

Never switch a drive circuit breaker off or unplug the drive before the Run light on the operator control panel goes off. HDA damage could occur.

2.7 RA90 OCP CONTROLS AND INDICATORS

The following section describes the RA90 operator control panel (OCP) switches and indicators. Refer to Figure 2-14 for locations of switches, LEDs, and the alphanumeric display.

2.7.1 Functions of the OCP

The operator control panel is the interface to the RA90 disk drive. The OCP performs the following functions:

- Selects and displays the unit address number.
- Selects Run, Write Protect, Port A, and Port B.
- Displays faults and error codes.
- Selects tests in the test mode.
- Controls the microcode update process.
- Communicates with the RA90 master processor.

NOTE

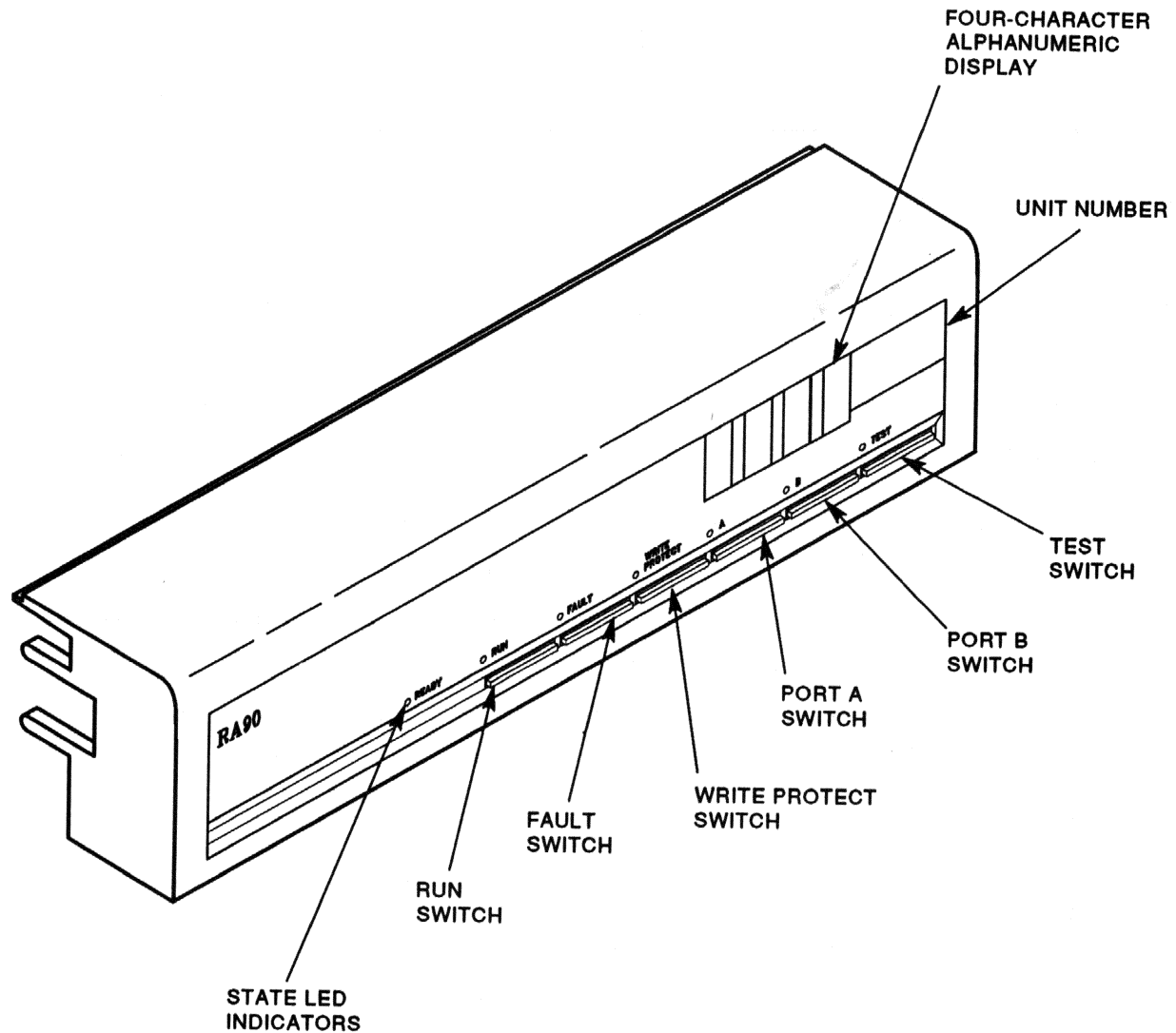
The microcode update process is a service function and is not covered in this manual.

The OCP functions are executed by using the following features on the OCP. Refer to Figure 2-14.

- Six input switches (Run, Fault, Write Protect, Port A, Port B, and Test).
- Seven LED indicators (Ready, Run, Fault, Write Protect, Port A, Port B, and Test).
- A four-character alphanumeric display.
- A microcode update port.

There are no physical in/out states for the RA90 front panel switches. Instead, the logical state of the switch changes each time you select an OCP switch. In addition, under normal operating conditions, the switch state is represented in the alphanumeric display by the use of a single alphabetic character. For example, selecting the Run switch causes an "R" to appear in the OCP display.

Chapter 3 has a more extensive explanation of the OCP and its functions.



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Figure 2-14 RA90 OCP

2.8 POWER-UP RESIDENT DIAGNOSTICS

Do not select any front panel switches.

A sequence of drive-resident diagnostics run when power is applied to the drive. The sequence consists of hardcore tests with basic processor tests.

Successful completion of the hardcore tests is indicated by a series of OCP displays, as follows:

1. Blank (1 second).
2. [WAIT] (16 seconds).
3. [0000] (The drive unit number, if previously programmed, is displayed. Otherwise, zeros are displayed.)

2.8.1 Problems at Power-Up

If the drive experiences problems, as indicated by a front panel Fault light (or if no front panel activity occurs), enter the fault display mode in order to determine the drive problem.

To enter the fault mode, select the Fault switch. The OCP then displays a three-character fault code in the format [E 00] (where 00 is a 2-digit fault code). (00) is a two-digit fault code.

If you have an error code (or if no front panel activity occurs), refer to Table 2-1 for possible solutions. Error codes not found in Table 2-1 indicate problems beyond the scope of this manual. Call DIGITAL field service.

Table 2-1 OCP Error Codes

Error	Description	Action
0F	Drive write protected	Disable write protection by the OCP Write Protect switch or turn off software write protection.
22	Drive over-temperature condition	Spin down and remove power from the drive. Ensure front filter is clean and that room temperature is within recommended limits. Call field service if filter or temperature has not caused an over-temperature condition.
2D	Power supply over-temperature condition	Spin down and remove power from the drive. Ensure front filter is clean and that room temperature is within recommended limits. Call field service if filter or temperature has not caused an over-temperature condition.
6F	Write protect error	Disable write protection by way of the OCP Write Protect switch, or turn off software write protection.

2.9 ACCEPTANCE TESTING

Do not select any OCP switches.

After the hardcore diagnostics have run successfully, the drive automatically enters an idle-loop diagnostic test sequence. This test sequence is indicated by the front panel Test LED lighting.

Allow the drive to remain spun down and in idle-loop testing for 5 minutes. If you do select the Run switch at this time, the drive will not respond until it has finished its current idle-loop routine.

If an error occurs during power-up or during idle-loop testing, the drive attempts to display an error code and a Fault light. Refer to Section 2.8.1 for possible solutions.

2.9.1 Operator Control Panel Lamp Testing

Next, perform an OCP lamp test. To perform an OCP lamp test, press the Test switch and then select the Fault switch. Deselect the Test switch.

2.9.2 Drive Testing Spun Down

The next step in the acceptance test process requires drive-resident diagnostics to run with the drive in the spun-down state.

To invoke resident diagnostics while the drive is spun down:

1. Select the Test switch (Test LED lights).
2. Select the Write Protect switch.
 - The OCP displays [T 00].
3. Select the Write Protect switch again to start testing.

The drive is now running a sequence of resident diagnostics. A number of displays are seen during the execution of the diagnostics. Refer to Figure 2-15 for an example of a normal test sequence.

DISPLAY =

T		0	1*
---	--	---	----

DISPLAY =

S		0	1
---	--	---	---

 (START)

DISPLAY =

C		0	1
---	--	---	---

 (COMPLETE)

DISPLAY =

S		0	2
---	--	---	---

* INDICATES FLASHING DISPLAY

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Figure 2-15 OCP Displays During Normal Testing

Allow drive diagnostics to run to completion before continuing acceptance testing. This will take about 2 minutes and terminate with [T 00].

If an error occurs, the drive displays an error code and a Fault light. Refer to Section 2.8.1 for possible solutions and operator actions.

Error codes not found in Table 2-1 indicate problems beyond the scope of this manual. Contact DIGITAL field service.

2.9.3 Drive Testing Spun Up

To spin up the drive:

1. De-select the Test switch (from the previous procedure). The Test LED extinguishes and the unit address is displayed.
2. Select the Run switch.

An "R" appears in the OCP display, and the Run indicator lights. Allow the drive to come to the ready state as indicated by the front panel Ready indicator.

Then:

1. Select the Test switch (Test indicator lights).

2. Select the Write Protect switch.
 - The OCP displays [T 00].
3. Select the Write Protect switch.

The previous steps invoke a sequence of 18 resident-diagnostic tests. The tests check drive functions in the following areas:

- Processor
- Servo bus
- Positioner
- Head select
- Read/Write circuitry
- Fault detection circuitry

Allow the tests to run to completion (about 4 minutes).

To halt testing:

1. Select the Port A/B switch.
2. Select the Test switch.

The drive exits the test mode and the OCP displays an "R" with the Ready and Run indicators illuminated.

The drive can now be placed on line assuming no problems have been encountered.

NOTE

If an error occurs, reference Section 2.8.1 for possible solutions and operator actions. Error codes not found in Table 2-1 indicate problems beyond the scope of this manual. Contact DIGITAL field service. Report the displayed error code when requesting service.

2.10 PLACING THE DRIVE ON LINE

The following procedure assumes drive acceptance testing and cabling procedures have been completed. If not, refer to the appropriate sections for details.

2.10.1 Programming the Drive Unit Address

You must set the drive unit address before the RA90 disk drive can be placed on line. The unit address can be set once power has been applied to the drive. The RA90 unit address is programmable from 0 to 4094.

Use the following procedure to set the drive unit address. Figure 2-16 is a flowchart of this procedure.

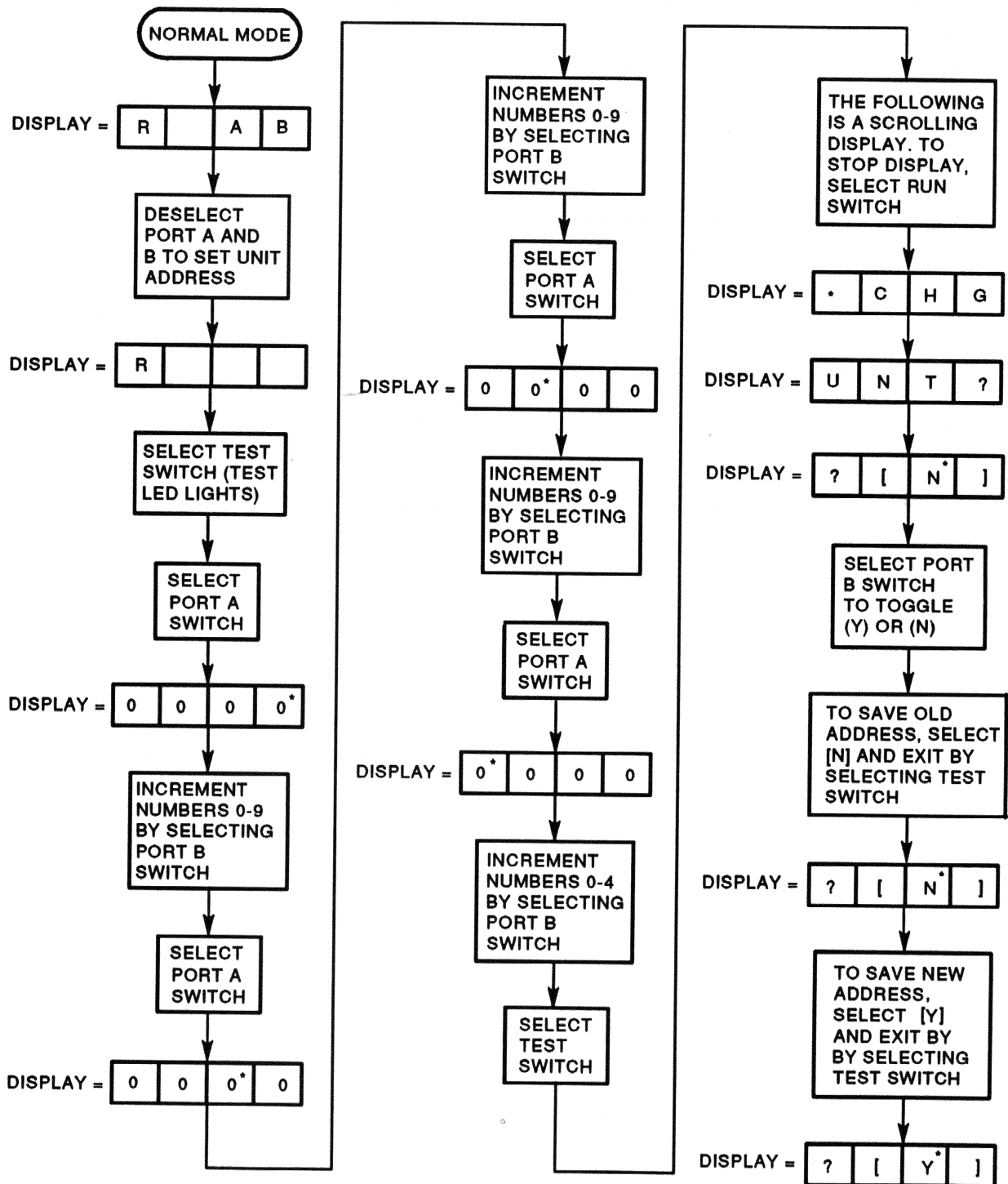
1. Select the Test switch. Test LED lights and a unit address is displayed.
2. Select the Port A switch for the ones position. Position zero (hex) blinks.
3. Select the Port B switch. Position zero increments one through nine for every time Port B is selected.
4. Select the Port A switch for the tens position. Position one blinks.
5. Select the Port B switch. Position one increments one through nine for every time Port B is selected.
6. Select the Port A switch for the hundreds position. Position two blinks.

7. Select the Port B switch. Position two increments one through nine for every time Port B is selected.
8. Select the Port A switch for the thousands position. Position three blinks.
9. Select the Port B switch. Position three increments one through four for every time Port B is selected.
10. Select the Test switch to exit.

At this point, the OCP prompts you to ensure that you want to change the unit address. The following messages are scrolled through the OCP display:

CHG UNT # [?<N>] (Change unit number [?<N>])

- If you elect not to change the unit address, select the Test switch a second time. The drive returns to normal mode.
- If you elect to change the unit address:
 1. Toggle the Port B switch.
 2. Result: [?<Y>] is now displayed.
 3. Select the Test switch. The old unit address is overwritten with the new address and displayed in the OCP, and the drive returns to normal mode.



* INDICATES FLASHING READOUT

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Figure 2-16 Unit Address Selection Flowchart

NOTE

The unit address is written to EEPROM and is not lost if the drive loses power.

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

Functions and uses of the operator control panel (OCP) are covered in this chapter. Also included are functional flowcharts intended to aid the user when operating the RA90 disk drive.

3.2 FUNCTIONS OF THE OCP

The operator control panel is the interface to the RA90 disk drive. Figure 3-1 shows the RA90 OCP. The OCP performs the following functions:

- Selects and displays the unit address number.
- Selects Run, Write Protect, Port A, and Port B.
- Displays faults and error codes.
- Selects tests in the test mode.
- Controls the microcode update process.
- Communicates with the RA90 master processor.

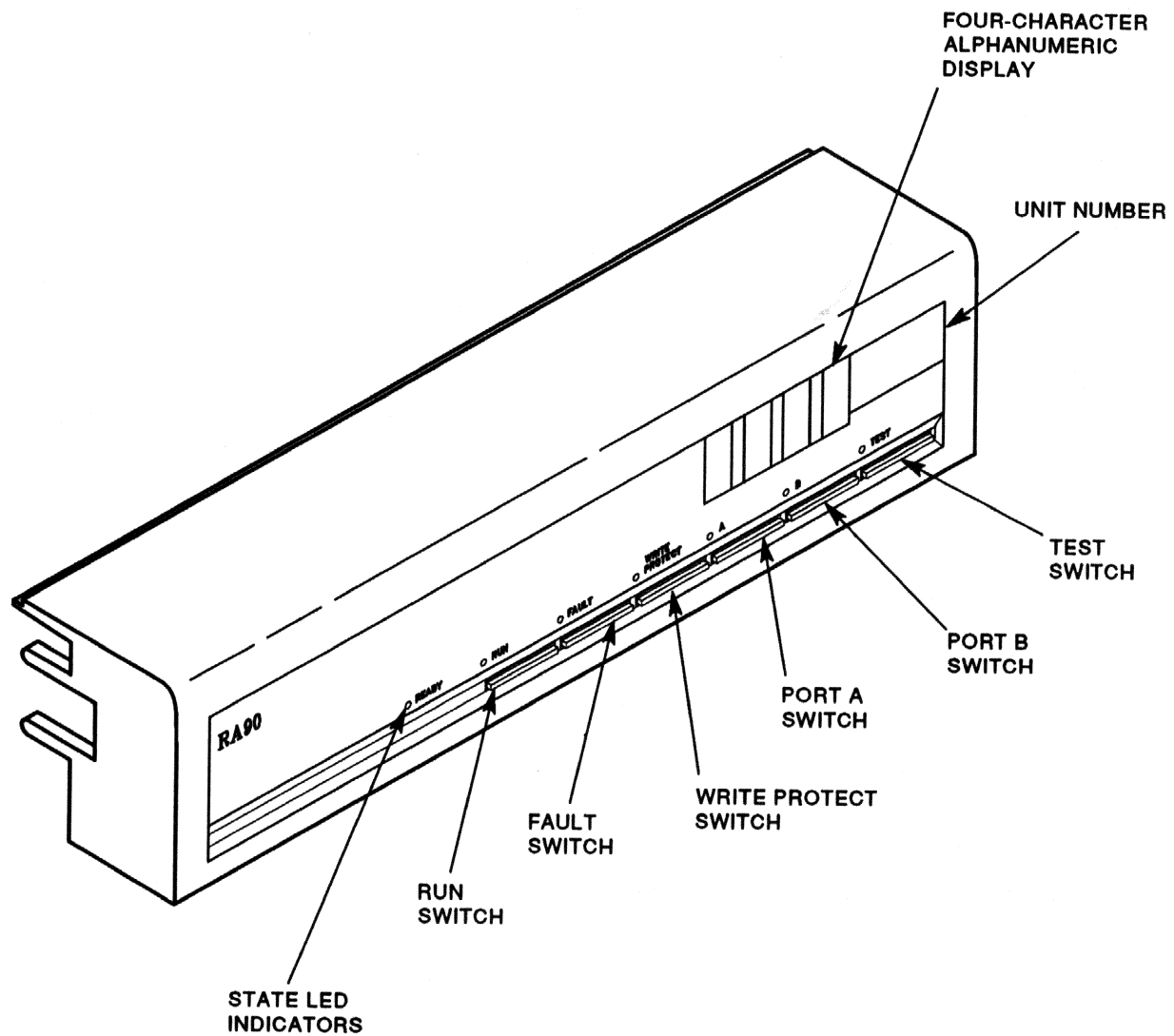
NOTE

The microcode update process is a service function and is not covered in this manual.

The listed functions are executed by using the following features on the OCP. Refer to Figure 3-1.

- Six input switches (Run, Fault, Write Protect, Port A, Port B, and Test)
- Seven LED indicators (Ready, Run, Fault, Write Protect, Port A, Port B, and Test)
- A four-character alphanumeric display
- A microcode update port

There are no physical in/out states of the OCP switches. Instead, the logical state of the switch is changed each time a switch is selected, similar to the way a calculator works.



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Figure 3-1 RA90 OCP

3.3 OPERATING MODES

The RA90 operates in three set-up modes: normal, fault display, and test. The following sections describe the functions of each of these modes.

3.3.1 Normal Mode Setup

The normal mode setup is the usual operating mode of the RA90. No Fault or Test LEDs are lit. The switch states are shown in the OCP display, and the LED indicators show the state of the drive relative to the controller.

Switch selection during normal operation usually consists of the Run switch, the Write Protect switch (for normal write protecting), and the Port A or B switch.

During normal operations:

- Selecting the Run switch causes an "R" to appear in the OCP display and the drive to spin up. Additionally, the Run indicator lights. The Ready indicator lights once the drive is up to speed.
- Selecting the Port A switch or the Port B switch displays an "A" or "B" in the OCP display and logically makes the drive available to the controller.
- Selecting the Write Protect switch logically write protects the drive and lights the Write Protect indicator.
- Selecting the Fault switch (without a fault indication) causes a 2-second OCP lamp test.
- Selecting the Fault switch (with a fault indication) displays an error code. See Section 3.3.2.
- Selecting the Fault switch a second time (with a fault indication) clears the fault.
- Selecting the Test switch (with Port A or B selected) causes a 2-second display of the unit address.
- Selecting the Test switch (without Port A or B selected) causes the drive to enter the test mode.

3.3.2 Fault Display Mode Setup

The fault mode can only be entered if the Fault indicator is lit. Otherwise, selecting the Fault switch causes a 2-second OCP lamp test.

To enter the fault display mode, select the Fault switch. An error code is displayed in the format shown in Figure 3-2.

DISPLAY =

E		0	F
---	--	---	---

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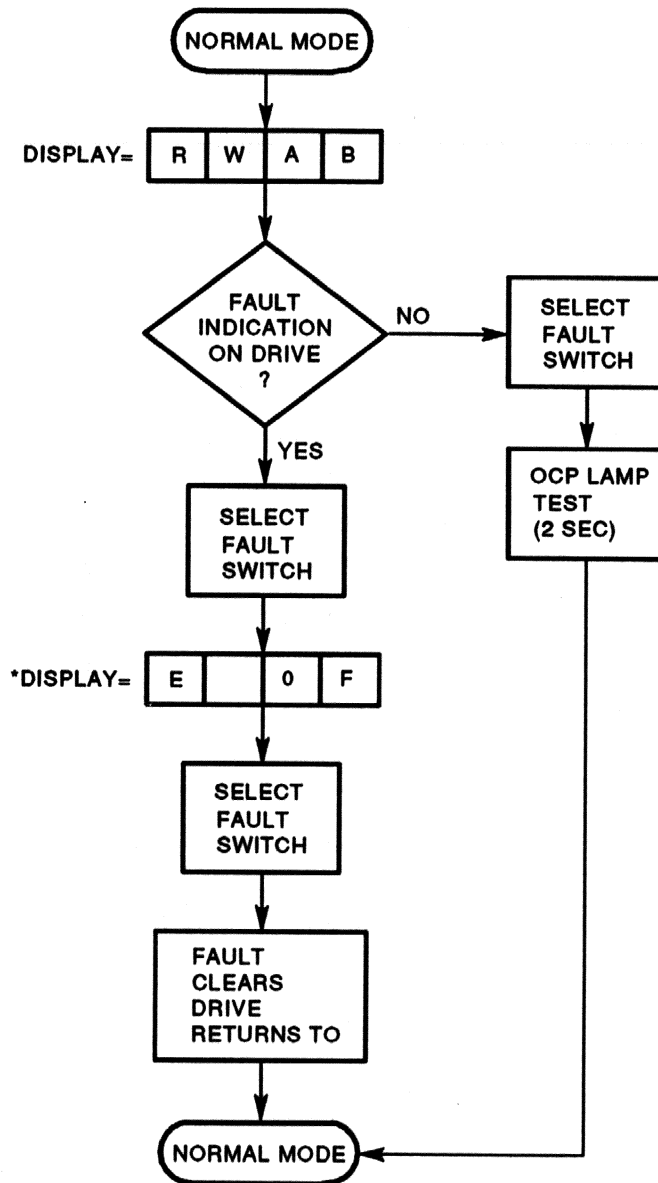
Figure 3-2 Fault Display Example

To exit the fault display mode and clear the fault, select the Fault switch a second time.

NOTE

Hard faults will not clear.

Figure 3-3 is a fault display mode flowchart.



*NOTE: ANY COMBINATION OF LEGAL ALPHANUMERIC ERROR CODES (HEX).

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Figure 3-3 Fault Mode Flowchart

3.3.3 Test Mode Setup

You must enter the test mode to set the RA90 unit address or to run resident diagnostic tests. In this mode, Port A and B switches have the function of selecting both the unit address numbers and test numbers. In addition, the port switches are used to abort running diagnostics. The Write Protect switch starts the tests and the Port A or B switches stop the selected tests.

The test mode is characterized by three displays. Figure 3-4 shows an OCP after test selection is made. Figure 3-5 shows a display while the test is running.

In addition, two flowcharts have been included as aids in setting the unit address (Figure 3-6) and selecting and running tests (Figure 3-7).

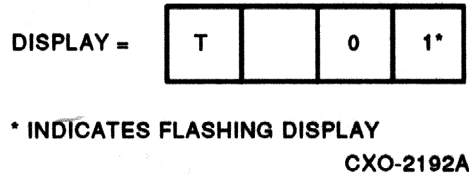


Figure 3-4 RA90 Test Display

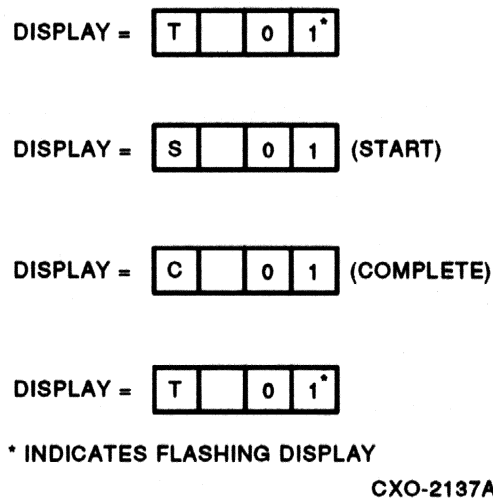


Figure 3-5 Running Test OCP Display

3.3.4 Programming the Drive Unit Address

The unit address can be set for the RA90 once power has been applied to the drive. The unit address is programmable from 0 to 4094.

Use the following procedure to set the drive unit address. Figure 3-6 is a flowchart of this procedure.

1. Select the Test switch. Test LED is lit and a unit address is displayed.
2. Select the Port A switch for the ones position. Position zero (hex) blinks.
3. Select the Port B switch. Position zero increments one through nine for every time Port B is selected.
4. Select the Port A switch for the tens position. Position one blinks.

3-6 OPERATING INSTRUCTIONS

5. Select Port B switch. Position one increments one through nine for every time Port B is selected.
6. Select the Port A switch for the hundreds position. Position two blinks.
7. Select the Port B switch. Position two increments one through nine for every time Port B is selected.
8. Select the Port A switch for the thousands position. Position three blinks.
9. Select the Port B switch. Position three increments one through four for every time Port B is selected.
10. Select the Test switch to exit.

The OCP prompts you to ensure that you want the unit address changed. The following messages are scrolled through the OCP display:

CHG UNT # [?<N>] (change unit number [?<N>])

- If you do not want to change the unit address, select the Test switch a second time. The drive returns to normal mode.
- If you want to change the unit address:
 1. Toggle Port B.
 2. Result: [?<Y>] is now displayed.
 3. Select the Test switch. The old unit address is overwritten with the new address and displayed in the OCP, and the drive returns to normal mode.

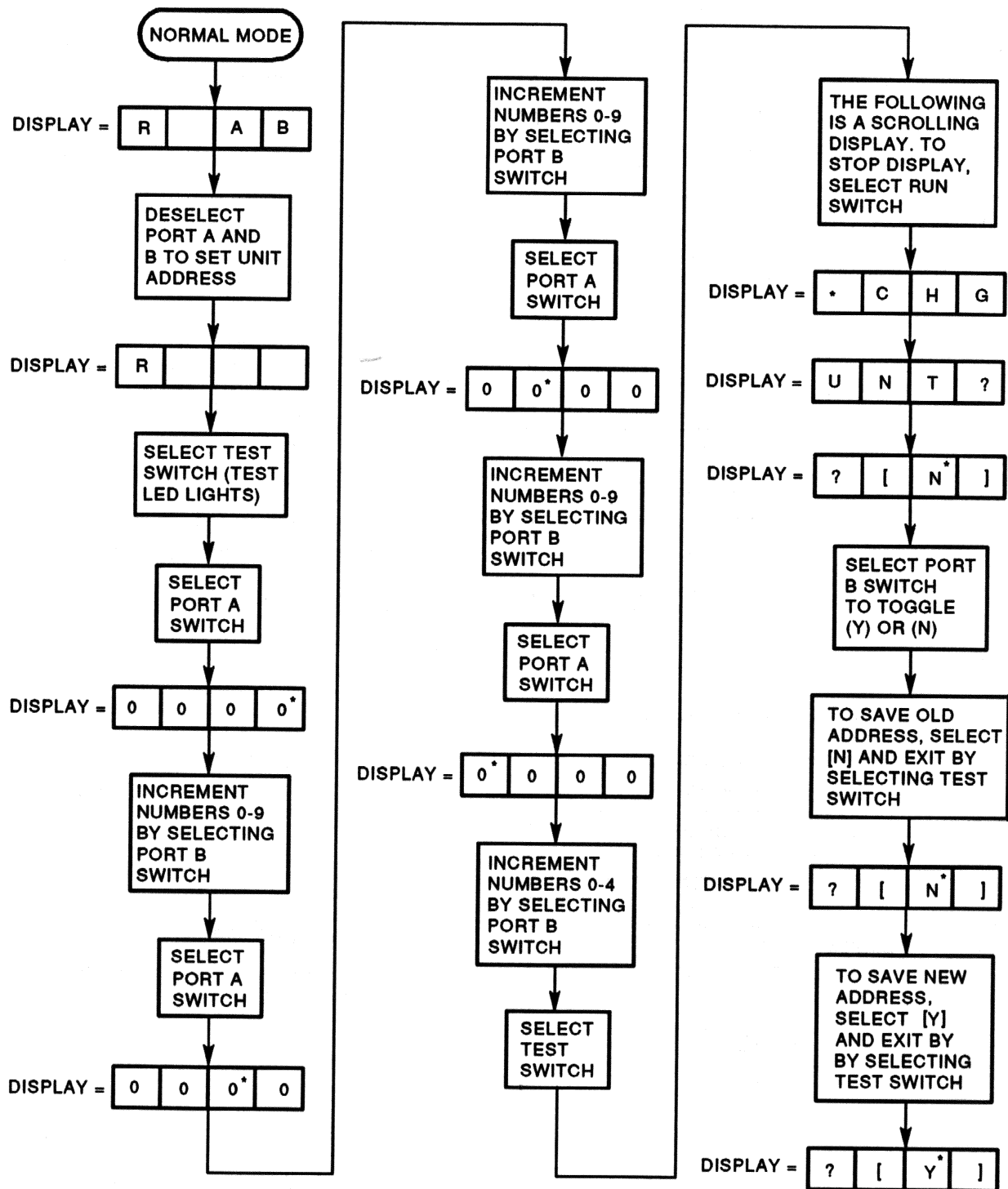
NOTE

The unit address is written to EEPROM and is not lost if the drive loses power.

3.3.5 Test Selection from the OCP

Select and run resident diagnostics from the OCP to complete acceptance testing. Use the following procedure to select and run diagnostics from the OCP. Refer to Figure 3-7 while performing this procedure.

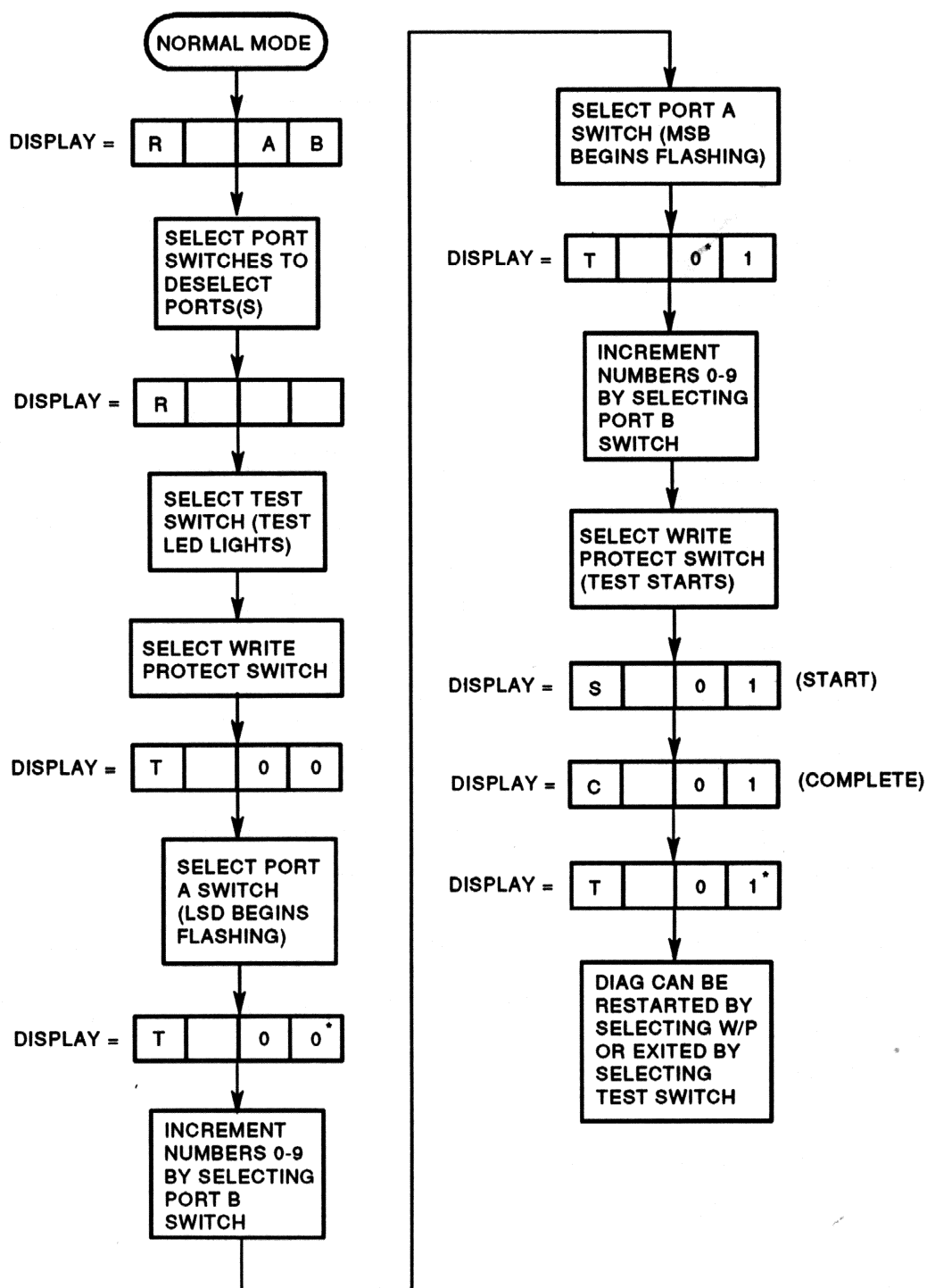
1. Power up the drive (if not done previously).
2. Select the Test switch. (Test defaults to zero; no other operator action is required.)
3. Select the Write Protect switch.
4. Select the diagnostic to run by using Port A and B switches. See the test mode flowchart (Figure 3-7).
5. Start the test by selecting the Write Protect switch.
6. Stop the test by selecting either the Port A or Port B switch.
7. Select the Test switch to exit the test mode.



* INDICATES FLASHING READOUT

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Figure 3-6 Unit Address Selection Flowchart



* INDICATES FLASHING READOUT

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Figure 3-7 Test Select Flowchart

DIAGNOSTICS AND UTILITIES

4.1 GENERAL INFORMATION

General information concerning drive-resident diagnostics and acceptance testing procedures are covered in this chapter.

4.2 DRIVE-RESIDENT DIAGNOSTICS

Three hardware areas are covered during drive-resident diagnostic testing. They are:

- Hardcore (CPU, ROM, RAM, SCI, and TIMER)
- Logic (processor board, servo board, and PCM board)
- Functional (guardband detect, seek/timing, and read/write)

Drive-resident diagnostics are invoked under four conditions:

- Power-up or master processor reset
- External init (SDI command)
- Operator control panel (OCP) test mode selection
- Functional firmware sequences (idle loop)

4.3 POWER-UP RESIDENT DIAGNOSTICS

At power-up or reset of the master processor, drive-resident diagnostics run. Upon successful completion of the tests, the drive displays:

- BLANK (1 second).
- [WAIT] (16 seconds).
- [0000] (The drive unit address, if set, is displayed. Otherwise, zeros are displayed.)

These tests run without manual intervention in the following order:

- Master CPU test
- Master ROM test
- Master RAM test

4-2 DIAGNOSTICS AND UTILITIES

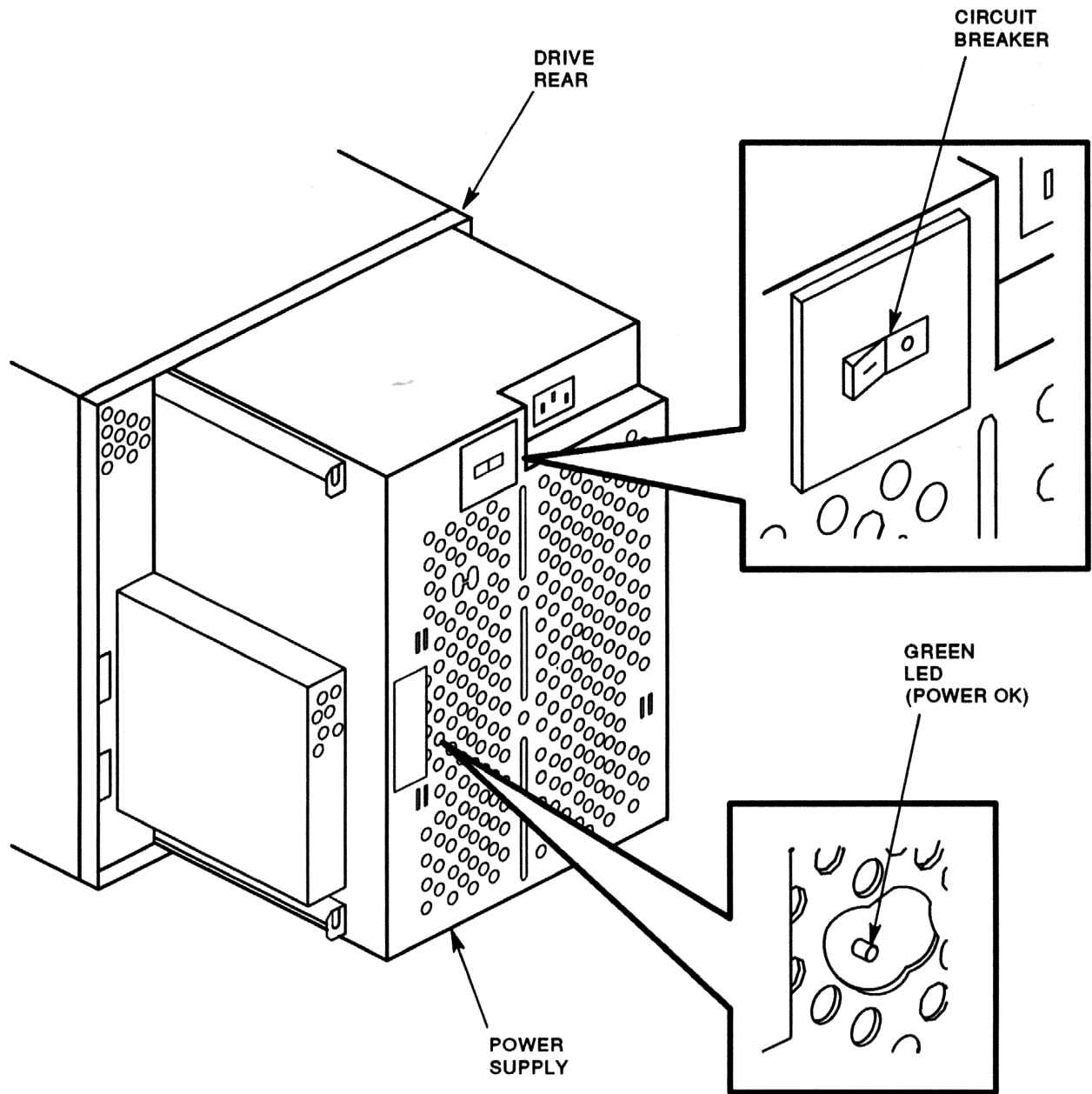
- Master timer test
- Servo data bus loopback test
- Head select test

This sequence is a power-up function and tests the basic processor functions. If a problem occurs during power-up, the drive attempts to display an error code.

However, should any of the basic processor functions fail without an error code being displayed, perform the following steps:

- Ensure the OCP is seated properly.
- Check ac power at the outlet.
- Check to ensure the green LED at the rear of the power supply is lit (Figure 4-1).
- Ensure the power supply is properly seated.
- Check the circuit breaker (CB1) on the back of the power supply.
- Ensure that drive FRUs are seated properly.

If the previous actions do not solve the problem, contact DIGITAL field service.



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Figure 4-1 Power Supply Indicator

4.4 TEST SELECTION FROM THE OCP

This section documents drive confidence testing.

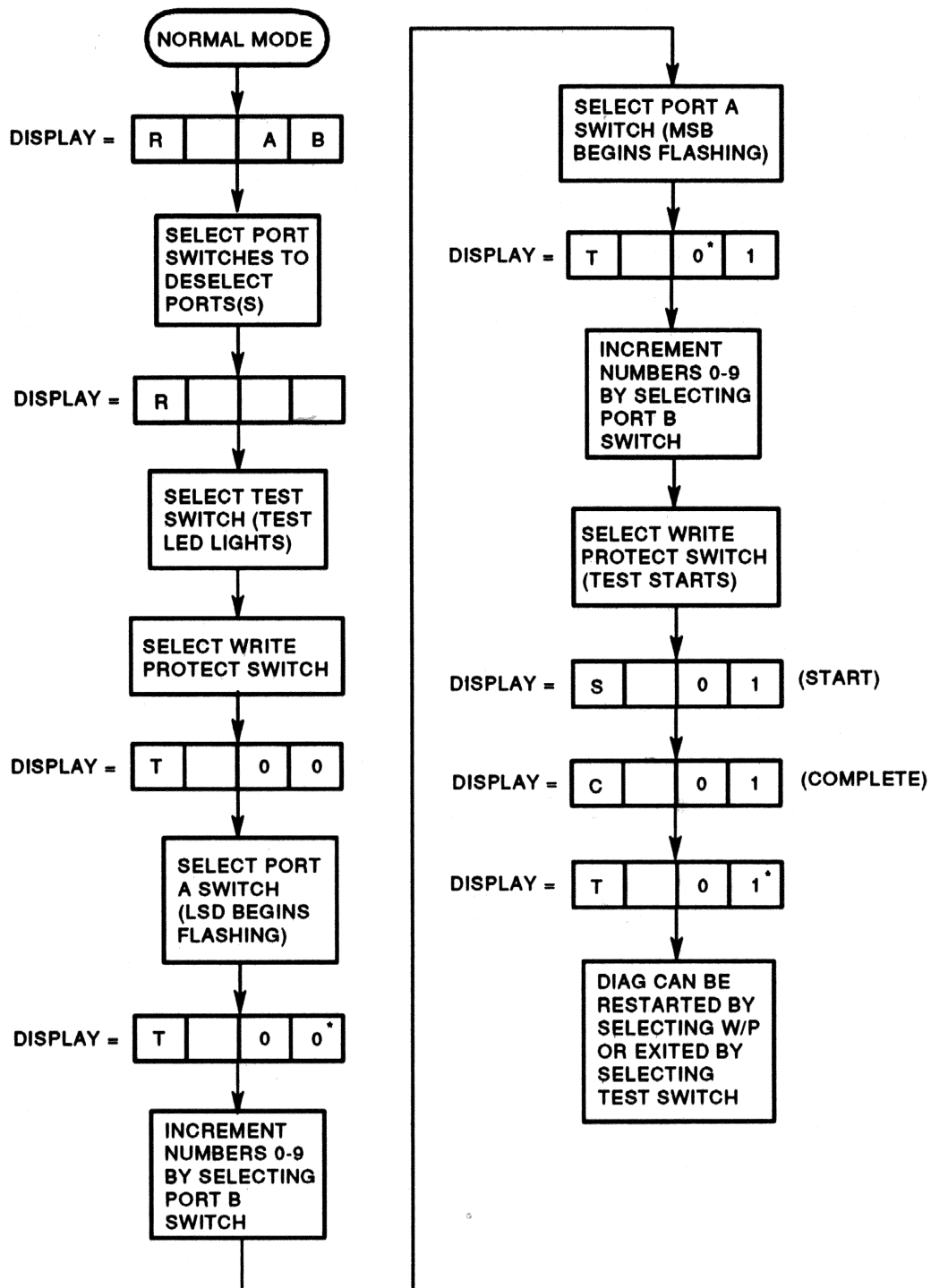
Run the following resident diagnostics from the OCP in the following order:

1. Test T 00: Drive spun down.
2. Test T 00: Drive spun up.

4-4 DIAGNOSTICS AND UTILITIES

To run resident diagnostics from the OCP, use the following procedure. (See Figure 4-2.)

1. Power up the drive.
2. Select the Test switch.
3. Select the Write Protect switch to initiate diagnostic mode.
4. Select the diagnostic to run by using Port A and B switches (Figure 4-2).
5. Start the test by selecting the Write Protect switch.
6. Stop the test by selecting the Port A switch.
7. Reinitiate the tests by selecting the Write Protect switch again. Select the Test switch to exit the test mode.



* INDICATES FLASHING READOUT

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Figure 4-2 Test Selection Flowchart

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